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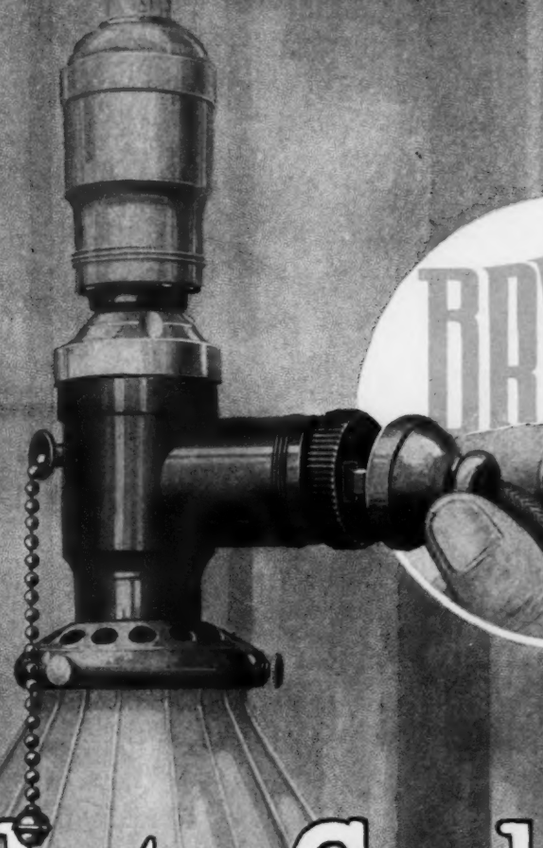

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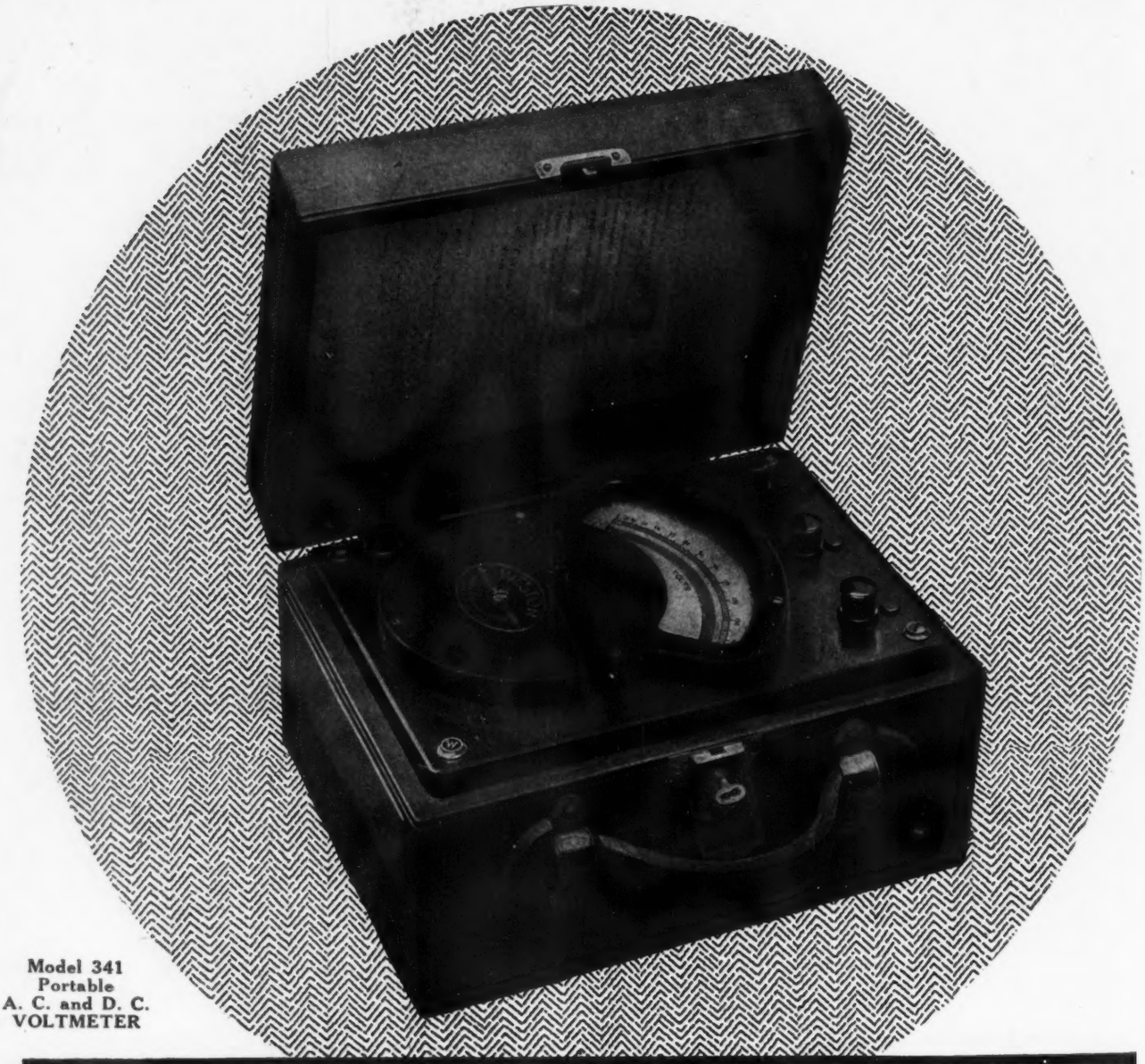

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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Research a Vital Necessity

FEW greater mistakes can be made than to put industrial research into the luxury class. The poorer concern needs it even more than its prosperous competitor. Shortages and wastes of materials are reduced by adequate investigation, labor productivity is enhanced and community wealth is enlarged.

Foreign Trade Appropriation

IT WAS gratifying to be able to report last week that the House of Representatives was decidedly opposed to the cut in appropriations for foreign trade made in committee. Just when the foreign trade of the world is beginning to feel the old competitive influences surely should be the time for increasing rather than reducing the helpful support given by the government through the Bureau of Foreign and Domestic Commerce. We are glad that the House has set itself against the penny-wise and pound-foolish viewpoint of the bill as reported by its appropriations committee.

Importing Electrical Energy

REFUSAL by the Connecticut Public Utilities Commission to permit an industrial company to build a transmission line to the Massachusetts border for the purpose of importing electricity is further recognition of the monopolistic rights of a public utility in the territory it serves. Such a decision by a utilities commission is not only to be expected by a distributing company but it is essential to the future development of networks built in the expectation of a return on the investment through obtaining the business which will arise from the increase in the demands of the district and the loads of new industries as they are established.

Service or Failure?

THERE is a lesson for electrical jobbers in the recent action of a Cincinnati soap concern which has announced that it will sell direct to dealers in New England. When asked for the reason the answer of an official was: "We are merely trying to attend to our own competition rather than trust it to the jobbers." The wholesale grocers, it seemed, were not fully co-operating with their natural allies, the manufacturers. Not only did many wholesale grocers have their own private brands, but they were in the market constantly as buyers of job lots of merchandise which they sold in competition with the goods of manufacturers for whom they acted as distributing agents. The complaint was made that the majority of jobbers' salesmen were merely order takers and that manufacturers' salesmen and not the jobbers sell the bulk of their output. Regardless of the right or wrong of this particular case, it deserves the attention of every jobber who is honestly trying to give manufacturers service—which in this case means better distribution than the manufacturer could give himself.

Standardization in Electrical Supplies

WITH the formation by the Associated Manufacturers of Electrical Supplies of a standards committee another strong factor will enter into the effort to eliminate those freaks in design whose chief merit lies in being different. Already, through the committee work of the American Institute of Electrical Engineers and through the American Engineering Standards Committee, much has been done in standardization along strictly scientific and engineering lines. The committees of the International Electrotechnical Commission which meet in Brussels the latter part of this month are working in the same direction with representatives of all countries. It thus remains for the Electric Power Club and the Associated Manufacturers of Electrical Supplies to translate standard recommendations into actual design specifications. This, it is hoped, will be one function, if not indeed the main one, of the new standards committee that will deal with electrical supplies. Otherwise there is danger that it may become a debating society, with postponement of standards ratification as its main accomplishment.

Purchasing Power of the Farmer

THE agricultural department of the University of California has estimated that the average gross income of the farmers of the United States is $6,000. It is customary to estimate about half the gross income as necessary to cover expenses, including labor, whose compensation might usually be said to bear a fixed ratio to the income of the farmer. This leaves only $3,000 as an average profit, which, when considered as representing interest on an investment averaging about $30,000 as well as the labor return to the farmer himself, is not large. Nevertheless, the increase in income has more than kept pace with increased living costs, and the effect is felt in purchasing power. The standard of comfort has always been high in Western agricultural districts, where more electricity is used than in any other farming district in the country, and the increased prosperity of the present year is shown in even larger demands for energy and larger sales of electric appliances. Figures recently published by the Bureau of the Census indicate that the central stations of California during the year 1917 generated 2,746,000,000 kw.-hr. of electrical energy as against 661,000,000 kw.-hr. in 1907, an increase of 315 per cent. Figures for last year are not yet available, but informal reports indicate a largely increased rural load.

Public Service Securities and the Consumer

THERE is food for thought in testimony recently given before the California Railroad Commission by a prominent savings bank official of the Pacific Coast. Savings banks, said this authority, alluding especially to conditions in California, are in the field for investments of a conservative kind yielding a growing rate of interest, a large portion of their investments in real estate mortgages having been paid off or amortized. The securities of public utilities have not in the past been in high favor, despite their natural attractiveness, owing probably to the deterrent influence of a few historical examples on the wrong side particularly among street railways—for investors do not always discriminate. Regulation by the public service commissions, however, is doing much to deprive such traditions of any force, and capital should flow to the utilities provided that they are not outbidden by other enterprises offering an equal degree of security and a higher rate of interest.

The consumer is more vitally interested in this aspect of public service than the investor. The latter can find other outlets for his money, but unless the public utility can attract to itself enough capital to stabilize its business and provide funds for extensions and improvements, the consumer cannot get the service he desires.

How closely public prosperity is bound up with that of the utilities was brought out in another statement of the witness, to the effect that the banks in the southern part of California are loaning heavily in the agricultural communities of the northern part. The development of farm lands in that section depends largely upon hydro-electric power for irrigation. If there shall be assurance that the supply of energy will be sufficient to meet the demand, the banks will not only lend on the land but will purchase the securities of the utilities and advise their clients to do likewise. This again is an indication that additional generating capacity where needed will help all along the line.

A Solution in the Three-Phase, Four-Wire System

THE inherent characteristics of the three-phase, four-wire system of distribution have compelled many central-station engineers to give serious consideration of its advantages in replacing systems that have been outgrown by the demands of their territory. The economy effected in the use of copper and the ability to regulate satisfactorily both single-phase and three-phase loads are advantages that in themselves recommend the adoption of the three-phase, four-wire system for new installations. When it becomes necessary to make some changes to accommodate the increase of load beyond the capacity of an existing system, the three-phase, four-wire system offers usually other advantages. A sufficient number of these point to its adoption as the best means of rehabilitating a system.

Some of these advantages are: The use of the same substation transformers as in the old system by reconnection of their terminals; the possibility of regulating twice the amount of power with the same regulators by connecting the regulator coils in parallel instead of in series; the use of the same switches and other equipment in the substation; a gain in total kilowatt capacity of the duct line by carrying more load in each duct; the use of the same cable if of sufficient insulation; the use of the same spacing of the wires on the poles and a saving in the number of wires necessary on account of the increased voltage, and the use of the same distribution transformers for the single-phase load. That some or all of these advantages are usually realized is shown by the fact that the three-phase, four-wire system of distribution has stood the test of the scrutinizing analysis of central-station engineers and has been adopted in many places with success. Moreover, this system offers a method of obtaining greatly increased line capacities without large outlays of capital. Under present conditions this is an important consideration.

How Manufacturing Companies Can Teach the Teacher

MANUFACTURING companies which have tried through permitted addresses made by their representatives at educational institutions to impress upon students the merits of particular wares have met little success. This has been due partly to the inability of commercial representatives or even of designing engineers to present their subjects impartially, clearly and interestingly and partly to the fact that a detached lecture, not connected with the rest of the course, does not leave much impression. Would it not be better if an organized effort were made by the leading electrical manufacturers and the principal operating companies to teach the teacher rather than to try to reach the student directly? This teaching of teachers is already being attempted in a sporadic and unsystematic way through brief summer courses offered by some large companies and through the promiscuous distribution of commercial literature most of which goes into the waste-basket without being read. We venture to suggest two other means that ought to prove much more effective.

One suggestion is that periodic trips to prominent colleges of engineering be made by broadly educated and competent engineers connected with the leading manufacturing and operating concerns. These men should not address the students but should have conferences with teachers only. A prominent designer of transformers may prove to be an ineffective speaker before a class of students, but a group of professors and instructors sitting with him around a table could elicit from him a large amount of valuable and inspiring information. What is particularly important, they would get the correct point of view as to the relative importance of the various subjects that they teach.

The other suggestion would be for the preparation of literature to go to the teachers—special information, blueprints, diagrams, operating and testing instructions, reports on difficulties in operation, interesting phenomena, etc. Such literature is ordinarily sent to the company's engineers only. The information usually conveyed in the bulletins and catalogs so generously sent to teachers is of little use to them, because the machinery is always shown covered and no real hint is given as to the principle on which it operates.

The problem of closely connecting colleges of engineering with industry has many sides. Teaching the teacher is only one of these. It is one, however, which has been neglected. This is the time of organized efforts, and the electrical industry should without further loss of time provide regular channels through which teachers of engineering could get practical, reliable and up-to-date information concerning their specialty.

Electric Ranges and Distribution

THE effect of electric ranges on the laying out of distribution systems is taken up elsewhere in this issue in a short article by H. P. Seelye. The author gives suggestions for coping with the new situation brought about by the large number of range installations being made everywhere and makes the best use possible of the available information on the load characteristics of these ranges. This information is still quite incomplete and will remain so until additional data are collected.

Mr. Seelye points out the way in which all distribution problems should be attacked. He dismisses the old-fashioned haphazard design with no definite thought of the future development of the region to be served and no appreciation of the economic laws governing such undertakings. He begins by clearly stating his problem—the actual conditions and the necessary assumptions. This is the first requisite of an engineering problem and an essential step toward a correct solution. He then eliminates the factors that do not affect his analysis, such as right-of-way, poles, crossarms, etc. Finally he devotes his attention to wire and transformers, finding the combination of these that will give the smallest annual charges under satisfactory service conditions. The analysis is based on a theoretical determination of the economical wire size, transformer spacing and transformer size for the load densities expected as limited by an assumed maximum allowable voltage drop. Then these theoretical findings are translated into practical entities under modification by the physical conditions of the problem at hand. Finally, having reduced to known quantities all the factors that could be so treated, the author applies his best judgment to the treatment of those factors that do not lend themselves to exact analysis and gives us the final solution of his problem.

It is to be hoped that the engineers who deal with these problems will soon be in a position to give us more definite information on the load factor and diversity factor of electric ranges. This information is essential to produce correct design of the distribution system that is to handle that load.

Paralleling Synchronous Frequency Changers

WHEN an alternating-current distribution network operating at one frequency, such as 25 cycles, is associated with a similar neighboring network operating at another frequency, such as 60 cycles, the two cannot be directly connected. Such a connection would produce a combination network operating at both frequencies and give rise to various difficulties, especially in the operation of motors. In order to bring the two networks into co-operative relation they are coupled through one or more frequency changers. The ordinary frequency changer consists of a pair of synchronous machines, one for 25 cycles and the other for 60 cycles per second, when running at the same speed, clamped rigidly together on the same shaft. Power then tends to be absorbed by one of the machines as a synchronous motor and delivered to the other as a synchronous generator through the common shaft. Frequency-changing sets require to be synchronized both on the motor and generator sides. Once set in action, however, they may continue to run for long periods continuously, with little superintendence.

The operation of a plurality of frequency-changer sets in parallel sometimes reveals curious actions. It may happen that two sets operating in parallel may apparently refuse to divide the load evenly between them. One of them may insist upon carrying an unduly large share. This peculiarity may usually be traced to some mechanical or electrical dissymmetry between the sets. A surprisingly small amount of mechanical dissymmetry in construction may involve a very noticeable amount of electrical dissymmetry in action.

The subject of controlling the division of load between parallel frequency-changer sets is discussed this week by Errol B. Shand. Five different methods of control are described. These different methods are by no means equally convenient or effective, but their relative merits are considered. The methods numbered three and five will probably be regarded as the most easily effected in an ordinary case.

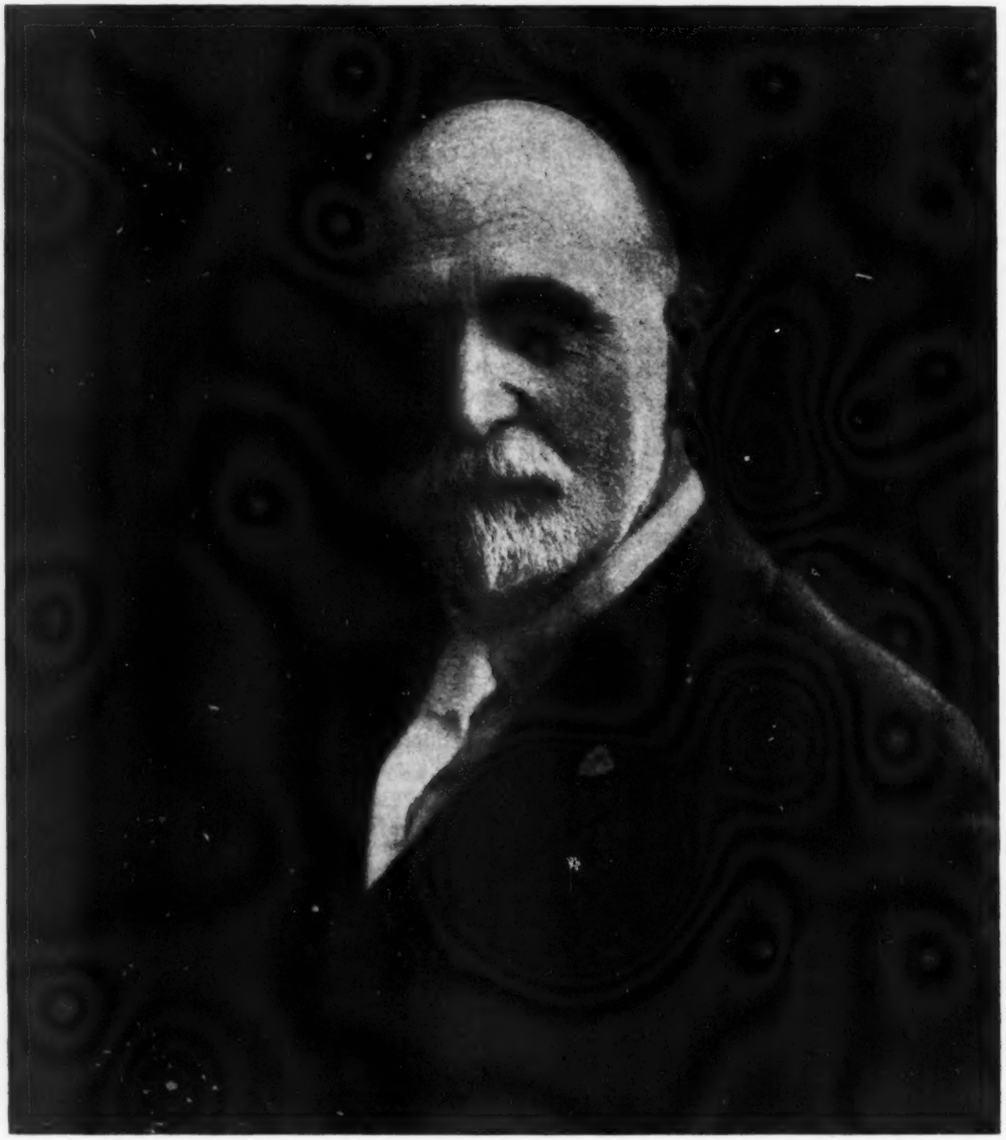
Meter Installation Tests

METERS installed on customers' premises require to be checked or tested at certain intervals in order to make sure that they are in proper working order. The expense of these routine tests is, in the aggregate, considerable and constitutes a very appreciable fraction of the total cost of metering to the central station. Moreover, state utility commissions frequently require such tests to be made within a short time after an installation is complete.

From the central-station standpoint, meters are much more likely to under-record than to over-record when they go wrong; so that errors, in the long run, tend to work against the company. The magnitude of the loss sustained increases with the size of the installation and the meter recording on it. Consequently it is most economical to test large meters at frequent intervals and to test small meters at long intervals. From the point of view of the customer, it is desirable, for his satisfaction, that the meters should be tested at regular and fairly frequent intervals.

The article of R. A. Keller which we print this week, and which is an abstract of a paper on the subject recently read before the Illinois State Electric Association, makes a plea for less frequent tests of the smaller induction meters and for the abolition of the first installation tests of such meters. The paper gives statistical tables of installation tests and of regular routine tests of meters of a number of types and sizes taken collectively. The results conform fairly well to the laws of accidental errors in free distribution. The data reported on the 2,473 installation tests indicate an average rate of nearly 100 per cent, with a probable error of about 1 per cent. The data reported on the 4,614 routine tests indicate an average rate of about 99.1 per cent, with a probable error of about 2 per cent. The data tend to show that the general run of the meters covered by the routine tests was slow nearly 1 per cent and had nearly double the probable error of the newer meters in the tests.

It is clearly to the advantage of the utility companies, the consumers and the state commissions that systematic records should be maintained of all meter tests made. From careful study of such records much can be learned for the benefit of all interested.



Alex Dow

A pioneer in the operation of large generating stations, an authority on rates and an advocate of the Golden Rule policy in dealing with the public

"I BELIEVE that the proper policy of electric light management under the conditions of the present is to sell electrical energy to every accessible user in any shape that the user requires and at the lowest price which will pay a reasonable profit on the capital invested." This statement was made by Alex Dow in a paper bearing the title "Electric Lighting for Profit" which he read at a meeting of the Northwestern Electrical Association at Milwaukee, Wis., on Jan. 19, 1898. He was then manager of the Edison Illuminating Company of Detroit, furnishing direct-current service through Edison tubes. When that company and the Peninsular Electric Light Company were consolidated to form the Detroit Edison Company, in 1903, this policy of providing electrical energy for any use and in any quantity was adopted by constructing the famous Delray power house. It has since been maintained, and the system output has increased from 14,600,000 kw.-hr. in 1904 to 872,500,000 kw.-hr. at the end of 1919. During that period Mr. Dow, as president and general manager of the Detroit Edison Company, has made detailed studies of possible economies in central generating stations and of rate schedules. He has also shown a marked leadership in perfecting relations with the public. The results of his own experience and details of his policies Mr. Dow has given liberally through the N. E. L. A. He has served twice as vice-president, in 1906 and in 1916, and as member of the public policy and executive committees. He also served as president of the Association of Edison Illuminating Companies from 1906 to 1908. Mr. Dow is one of a small group of men now living and in control of metropolitan public utilities on whose sound judgment, practical experience and operating and management ideals it may be said that the present high quality of central station service in this country has been built.

Pulverized Coal in Central Stations

Tests of Its Uses in Furnaces Showed 80 Per Cent Efficiency—No Clinkering of Coal, No Cleaning of Fires, No Smoke—Load Fluctuations Easily Handled

By JOHN ANDERSON

Chief Engineer of Power Plants, Milwaukee Electric Railway & Light Company

EARLY in 1918 the Milwaukee Electric Railway & Light Company decided to determine the feasibility of burning pulverized coal and made a trial installation on one of the 468-hp. boilers in its Oneida Street power plant. After certain changes were made the installation proved so successful that four more boilers of the same size were similarly equipped. The powdered coal fuel installation constitutes practically one-half the boiler capacity of the plant and is sufficiently large to compare directly with the other boilers in this station having underfeed stokers. The latter are subjected to practically the same operating conditions as the boilers under which the pulverized fuel is burned.

With the Lopulco system applied to the five boilers, the gross efficiency of the boiler and furnace burning dry pulverized 12,810-B.t.u. (1,460 cal. per kg.) coal was 80.67 per cent over a test period of four days compared with 76.8 per cent efficiency for the stoker section of the

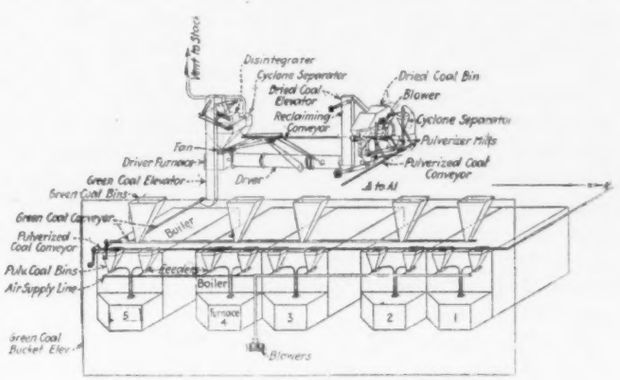


FIG. 1—ISOMETRIC LAYOUT OF PULVERIZED FUEL INSTALLATION IN MILWAUKEE

Screenings are delivered to the station by barge, run over an automatic scale, discharged onto a short-belt conveyor equipped with magnetic-separator pulley for removal of tramp iron and then into a Peck carrier which conveys them to the green-coal storage bunkers. From this point the green coal is conveyed and elevated to a Jeffrey disintegrator, where it is prepared for drying by being crushed, discharged into a small storage bin and fed to the dryer. The dryer is of a double-shell type and is so arranged that the gases exhausted from it are discharged through a cyclone separator where coal dust carried from the shell is reclaimed and conveyed to the pulverizers. The gases discharged from the separator are vented into the smoke-stack. The dried coal is carried from the dryer discharge by a bucket elevator to the dry-coal storage bins, to which are connected the pulverizer feeders. The pulverizers are of the five-roll Raymond type. Pulverized coal from the mill outlets is carried by screw conveyors to the pulverized-fuel storage bins. Screw feeders take the fuel to the air-mixing chamber, from which it is blown in to the furnaces.

plant. The boilers were subjected to regular normal operation except that the rating was held at practically a constant figure of 120 per cent and no special effort was made to obtain an efficiency which would not be obtained under normal plant operation.

After observing the tests Paul W. Thompson, technical engineer of power plants for the Detroit Edison Company, said: "The boiler-room operation was indeed much simpler than is obtained with a stoker installation. The rate of steaming of the boiler is controlled by varying the speed of the feeder motor and adjusting the damper to take care of the different quantity of flue gas. It is unnecessary to look into the furnace at frequent intervals, as is the case when firing with stokers and where holes in the fire or heavy spots must be corrected. Variations in the kind and quality of fuel burned seemed to have no effect on the operation except that when feeding at a constant quantity the rating of the boiler varied with the heating value of the coal.

Many inconveniences experienced with stokers are eliminated. They include break-downs in the stoker itself, breaking up of clinkers, loosening clinkers, con-

TABLE I—TEST OF FIVE 468-HP. BOILERS USING PULVERIZED COAL

Oneida Street power plant of the Milwaukee Electric Railway & Light Company, Nov. 11-15, 1919

DIMENSIONS	
Number and kind of boilers	Five Edge Moor water-tube boilers
Kind of furnaces	Lopulco pulverized-fuel-burning furnaces
Volume of combustion space, per boiler, cu.ft.	1,678
Water heating surface, sq.ft., per boiler	4,680
Superheating surface, sq.ft. per boiler (approximate)	594
Kind and size of coal	Mixture of 50 per cent Yough'ogheny screenings and 50 per cent Eastern Kentucky screenings
AVERAGE PRESSURE, TEMPERATURES, ETC.	
Steam pressure by gage, lb. per sq.in.	167.8
Temperature of steam leaving superheaters, deg. Fahr	441.9
Temperature of feed water entering boiler, deg. Fahr	156.6
Temperature of escaping gases, deg. Fahr.	496.6
(a) Temperature of flame above hearth, deg. Fahr.	2,767
(b) Temperature of furnace bottoms, deg. Fahr.	2,180
Draft under damper, inches of water	0.173
Draft in furnaces, inches of water	0.031
Air pressure at blower, inches of water	6.36
(a) Pressure of air mixing with coal at screw feeder, inches of water	6.00
(b) Pressure of air and coal mixture above burner outlet, in. of water	1.00
HOURLY QUANTITIES AND RATES	
Slag, ash and refuse (dry, laboratory basis) per cent	11.90
(a) Withdrawn from furnace bottom, pounds per hour per boiler	19.8
(b) Withdrawn from tubes, flues and combustion chamber, pounds per hour per boiler	20.0
(c) Blown away with gases, pounds per hour per boiler	176.8
Percentage of total lost with gases	82.8
Percentage of combustible in slag from furnace and ash recovered from combustion chamber, per cent (combined analysis)	6.9
Factor of evaporation	1.1473
Dry coal per hour per boiler, lb.	1,796
Water evaporated per hour per boiler, lb. actual	16,666
Equivalent evaporation per hour from and at 212 deg. Fahr. per sq.ft. of water heating surface, lb.	4.09
CAPACITY	
Percentage of rated capacity developed	118.4
ECONOMY	
Equivalent evaporation from and at 212 deg. Fahr. per pound of coal, as received, lb.	9.879
Equivalent evaporation from and at 212 deg. Fahr. per pound of coal, dry, lb.	10.649
GROSS EFFICIENCIES	
Gross efficiency of boiler and furnace, per cent	80.67
Efficiency of furnace, per cent	99.79
ANALYSES OF FLUE GASES	
Carbon dioxide, per cent	12.26
Oxygen, per cent	6.82
Carbon monoxide, per cent	0.00

ANALYSES OF COAL

	As Received	As Fired	Dry
Calorific value of 1 lb. of dry coal by calorimeter, B.t.u.			12,810
(a) Moisture	7.23	0.67	.....
(b) Volatile	32.13	34.40	34.63
(c) Fixed Carbon	49.60	53.11	53.47
(d) Ash	11.04	11.82	11.90
(e) Sulphur separately determined referred to dry coal			1.62

Analyses of—	Slag	Combustion Ash Retained	Combustion Ash Lost
(a) Moisture	0.00	13.00	
(b) Combustible	0.59	13.76	Unknown
(c) Earthly matter	99.41	86.24	

FEATURES OF HEAT BALANCE CALCULATED BY A.S.M.E. METHOD	
Loss due to evaporation of moisture in coal, per cent	0.06
Loss due to combustible in ash, per cent.	0.18
Loss due to combustible carried away with flue gases, unconsumed hydrogen, hydrocarbons, radiation and unaccounted for, per cent.	3.07

tinually watching the fire to maintain correct and uniform thickness, dumping and watching the gas passes of the boiler to prevent large sparks which indicate a carrying away of combustible. From the standpoint of reliability of operation the odds are in favor of the pulverized fuel. This is an item for serious consideration in plants where the losing of a boiler due to stoker trouble at the time of maximum load might make it necessary to drop a portion of the load.

"On several occasions during the first and second day of the test, slagging occurred in the furnace due to not admitting a sufficient quantity of air. The direct cause of this was the over-anxiety on the part of the men conducting the test to obtain a higher percentage of CO_2 in the flue gas. The reduction in the excess air permitted the furnace temperature to rise to a point where slagging occurred. The removing of this slag from the bottom or floor of the furnace twice every twenty-four hours presented more difficulty than is usually experienced in removing the refuse from the ash hopper of a stoker-fired boiler. The slag had to be broken up and pulled out before it fused to the brick lining of the furnace. It appeared, however, that this formation of slag could have been almost entirely eliminated by a more frequent inspection of the floor of the furnace and the admitting of more air through the openings in the front of the furnace when it was found that slag was beginning to form. Even at times of removing this slag it was possible to maintain the rating on the boiler by increasing the coal feed. This practice resulted, however, in a decreased efficiency during the cleaning period, which lasts about forty-five minutes every twenty-four hours for each boiler.

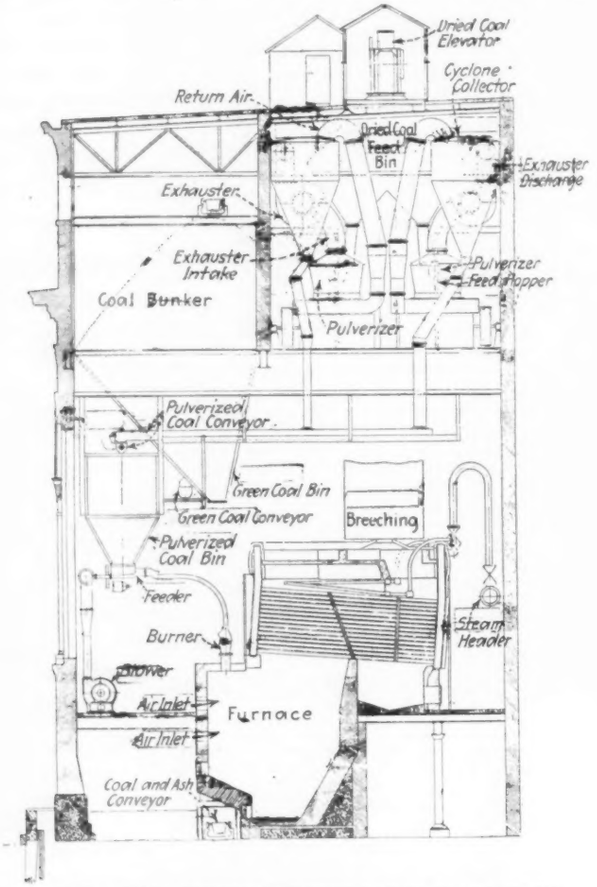


FIG. 2—CROSS-SECTION THROUGH BOILER PLANT USING PULVERIZED COAL

TABLE II—TEST ON FUEL-PULVERIZING EQUIPMENT
November 11-15, 1919

GENERAL CONDITIONS—AVERAGE TEMPERATURES, ETC.	
Vacuum in pulverizers, inches of water, average	5.08
Temperature of coal entering dryer, deg. Fahr.	88.2
Temperature of coal leaving dryer, deg. Fahr.	137.9
Temperature of coal leaving pulverizers, deg. Fahr.	169.7
Moisture of coal entering dryer, per cent	5.59
Moisture of coal leaving dryer, per cent	1.61
Moisture of coal leaving pulverizers, per cent	1.03
Fineness of pulverized coal, 200 mesh, per cent	81.30
100 mesh, per cent	18.20
60 and 80 mesh, per cent	0.5
TOTAL AND HOURLY QUANTITIES	
Coal crushed per hour, as received, tons	17.5
Total coal dried per hour of dryer operation, as received, tons	6.7
Coal pulverized per hour, dry, tons, total	7.90
Grease consumed on all equipment per ton of coal, as received, lb.	0.040
Oil consumed per ton of coal as received, qt	0.036
ELECTRIC ENERGY AND COAL CONSUMPTION	
Energy consumed by crusher and green coal elevator per ton of coal, as received, kw.-hr.	0.47
Energy per ton of coal, as received, consumed by dryer	1.53
Energy consumed by pulverizer per ton of coal, as pulverized, kw.-hr.	17.90
Total energy consumed by pulverized coal conveyors, feeder blowers and feeders per ton of coal as fired	4.00
Energy consumed by all equipment on preparation and firing of pulverized fuel per ton of coal, as received, kw.-hr.	22.45
Coal used in dryer furnace per ton of fuel dried, lb. (based on coal as received)	25.66
Total coal and equivalent consumed in preparation and firing of one ton of pulverized fuel, lb.	59.34

"A large portion of the ash resulting from combustion is carried through the passes of the boiler and out of the stack. Owing to the fineness of this ash it is apparently carried a considerable distance even in a moderate wind. Throughout the test there was a moderate wind blowing probably between 4 and 8 miles (6 km. to 13 km.) per hour, and there was no noticeable deposit in the streets even during the periods of blowing the deposit of ash from the boiler tubes, which was done three tmes a day, requiring about twenty minutes per boiler for each blow. At no time during the test was there any tendency for slag to form on the tubes of the boiler. The flues were blown down once every eight hours during the test. Back-chamber ash was removed once every two days."

Mr. Thompson did not believe that the efficiency obtained with the use of pulverized fuel exceeded that which had been obtained from the best stoker practice under constant boiler rating. However, he said: "Under normal operation the elimination of the many variable conditions entering into stoker operation should result

TABLE III—COST COMPARISONS BETWEEN PULVERIZED FUEL AND MECHANICAL STOKERS

	Pulv.-Fuel System	Modern Stoker
ELECTRIC ENERGY AND FUEL CONSUMPTION PER TON OF COAL BURNED		
Energy consumed by conveyors, crusher, elevators, dryers, fans and feeders, kw.-hr.	5.73	*10.94
Energy consumed by pulverizer, kw.-hr.	16.72	.....
Total energy, kw.-hr.	22.45	10.94
Coal equivalent at 1.5 lb. per kw.-hr., lb.	33.68	16.41
Coal consumed in dryer furnace, lb.	25.66	.....
Total coal and equivalent, lb.	59.34	16.41
COST OF FUEL PREPARATION, FIRING AND ASH DISPOSAL		
Labor†—coal preparation	$0.143	$0.000
Labor—firing	.112	.140
Labor—ash removal (in plant)	.025	.064
Dryer fuel—coal at $4 per ton	.051	.000
Electric energy—coal per kw.-hr. at 1.5 lb.	.068	.033
Maintenance:		
Labor at 3.6 cents, material at 2 cents (manufacturer's estimate), lubricants at 0.7 cents	.063	.....
Labor at 4.6 cents, material at 4.9 cents, lubricants at 0.2 cent	.....	.097
Total cost of fuel preparation, firing, ash disposal and maintenance	.462	.334
Price of coal as purchased, per ton	4.000	4.000
Total cost, per ton	4.462	4.334
Cost per ton of coal in pulverized fuel system over modern stoker	.128	.....

*Stokers and blowers.
†Based on the labor required to pulverize coal sufficient for five boilers through a twenty-four-hour run per day.

in higher all-day efficiency for the pulverized-fuel installation. Over-all efficiencies of boiler, furnace and grate as high as 82 or 83 per cent have been obtained on test with stoker-fired boilers, but normal operation day in and day out seldom exceeds 76 per cent in the very best practice where highly skilled help is employed in supervising the boiler-room operation. The gross over-all efficiency of boiler and furnace of 80.67 per cent as obtained from the results of this test, would unquestionably have been higher had the boilers been cleaned prior to the test. Each boiler had been in operation prior to the test approximately 600 hours after being entirely cleaned, and three of the boilers had been in operation approximately 300 hours since cleaning the first four rows. As the boiler-feed water consists of approximately 90 per cent untreated water, the scale formation in the tubes tended to give a lower efficiency than would have been obtained if the boilers had been clean."

The results obtained in this pulverized fuel-burning plant, where the equipment was installed and made to fit into an old plant originally equipped with stokers, are so gratifying that the Milwaukee Company has decided to use this kind of fuel in a 200,000-kw. station now being built. There are many improvements which can be made in the new plant, especially in the design of furnace, location of drying and coal-pulverizing equipment, method of coal handling, drying and pulverizing, method of ash handling, slag prevention and possibly of using waste gases for the drying of fuel, all of which will have an effect on the efficiency.

The tests which are given here were conducted by engineers of the Milwaukee (Wis.) Electric Railway & Light Company under the direct supervision of Fred Dornbrook, of the engineering department assisted by Messrs. Schubert and Mistele.

Head of Philadelphia Utility Champions Aggressive Policy

IN SUBMITTING to the stockholders of the United Gas Improvement Company a plan to authorize $15,000,000 of cumulative preferred stock at 7 per cent, of which more than $6,000,000 would be at once offered to the present stockholders at par, constituting a 10 per cent allotment, President Samuel T. Bodine expresses his belief in the wisdom of public utilities in growing communities adopting a vigorous policy of improvement as the proper way to meet present financial conditions, despite the stringent nature of the present money market. He says:

"It is the policy of the state utility commissions and municipal authorities to discourage establishment of competing companies where the existing company gives good service and extends its plant to care for new business offered at remunerative rates. War conditions have narrowed the market for securities of gas and electric companies, largely because the increased cost of labor and materials entering into the production of gas and generation of electric energy have not been fully offset by increases in the rates that have been allowed by public authorities.

"Your directors believe it is wise now to make provision against a possible continuance of these conditions for two or three years by creating a security so attractive to our stockholders and others that it will find a ready market."

Alex Dow, On the Business Outlook

Sees a Busy Year Ahead with Need for Higher Rates if Operating Conditions Are Not More Favorable

ALEX DOW, president of the Detroit Edison Company, foresees a busy year in 1920 and justification for pushing the constitution program.

"All the indications which guide us in making estimates for the future lead to the belief that 1920 will be a busy year, and they amply warrant us in pushing our construction program," says Mr. Dow in his report to stockholders for 1919. "We have more new business under contract and more inquiries and prospects than at the end of any year in our history. The generating plants are more than fully loaded. The new turbo-generator now being erected and its companion, which should be in service in May, will be needed before they are ready."

Among other subjects which Mr. Dow discusses are the rate situation and the elements entering into the high level of the operating ratio. He says:

No changes in our rates were made in 1919. Our attitude as to possible increases of rates has remained as expressed by us in our report a year ago, namely, that while our rates are apparently too low, we deem it better to let their readjustment lag somewhat and be based on proved conditions than to risk error in making premature changes. The margin between income and outgo is certainly inadequate at the present time. If the new year shall not bring more favorable operating conditions, a substantial increase in rates will be in order.

The operating ratio remains very high, being 68.9 per cent. Last year the ratio was 67.2; in 1917, 63.8, and in 1916, 54.5. That this figure should have continued to increase is a disappointment. We did not deceive ourselves into expecting in 1919 any fall in prices of fuel and other supplies, or in the wage rate, but we did expect an opportunity to redress certain inefficiencies of production which developed during the two war years. That opportunity did not come. There was no lessening of the demand upon our power houses, not even during the period while local industries were changing from war work to their ordinary work; and after that period there was a continuous increase in the demand, with the result that the steam plants (including reserve machines) have been running fully loaded and, latterly, overloaded. The arrival of new equipment which would have given a much needed relief was postponed by strikes in factories producing such equipment and by delayed release of manufacturing facilities and raw material which had been held for war uses. The first of two 30,000-kw. turbines, contracted for three years ago, arrived in Detroit in Christmas week of 1919.

In 1916 our plants attained their highest mechanical efficiency, and our operating organization was at its best both as to method and as to personnel. We have every expectation of restoring during 1920 the good mechanical conditions of 1916, and we have already, under difficult conditions, made a good start toward re-establishment of the efficiency of organization which was impaired during the war by the absence of so many good men and is still disturbed by the readjustments sequent upon their return.

This company at the present time is paying the highest wage rates it has ever paid. The Detroit scale has always been above that of similar industrial districts and considerably above the average for the country; and this company's scale has been a little above the local scale. The quick resumption of all industrial activities after the war, and continued increase thereof, and the release of many building and public works projects which had been deferred for two years or more, have served to maintain and to raise these wage differences.

Paralleling Synchronous Frequency Changers

Five Methods Are Outlined for the Control of Load Division Between Synchronous Frequency-Changer Sets—Some Schemes Give Good Approximate Results, While the Effect of Others Depends Upon the Load

By ERROL B. SHAND
Wilkinsburgh, Pa.

THE growth of systems operating at both 25 cycles and 60 cycles has brought about the considerable use of synchronous frequency-changer sets. With the present tendency toward interconnection of electrical systems, moreover, the application of such motor-generator sets should be increased. In this article the general principles upon which load division of alternating-current machines depends are first outlined and these principles are then applied to the consideration of five specific means of controlling load division between frequency-changer sets operating in parallel. While some of the methods are not in practical use, it is worth while to consider their characteristics.

Phase Displacement and Load Division

When two alternators driven by prime movers are operated in parallel, the portion of the kilowatt load taken by each machine is dependent upon, generally speaking, the governor settings of the two prime movers, any deficiency of magnetization in either machine to carry this portion of the load being supplied by magnetizing currents from the other alternator.

In the case of two synchronous frequency-changer sets operating in parallel on both the incoming and outgoing lines it is somewhat different, for the speed of the generator of each set is controlled from the same source, namely, the frequency of the incoming line. However, it should be realized that it is not as if both generators were coupled rigidly together, but rather they might be considered as driven from a common source each through a slender shaft admitting considerable torsional strains or angles of twist, these strains being proportional to the torques developed in the respective shafts. Such an arrangement is shown in Fig. 1. When the two generators *A* and *B* are operated thus in parallel the distortion of the shaft is one of the factors producing stable operation.

One of the principles governing the parallel operation of synchronous machines is that if there tends to be difference of phase angle between the terminal emfs. of two machines in parallel, a power component of current will circulate between them, increasing the load on that machine whose phase angle tends to advance, and decreasing the load on the other. Applying this principle to the case in question, if one machine tends to advance in phase position, the increased load will produce a corresponding increased torsional strain in its shaft, causing the poles to drop back until the terminal voltage coincides with that of the other machine, which will have advanced in phase position by the reverse process.

This torsional effect just mentioned in connection with the motors is also found in the generators. It will be referred to as "phase displacement of voltage with load," or simply "phase displacement," and its causes are armature reaction and inductance.

Fig. 2 (a) is the ordinary vector diagram for an alternator where:

E_{ta} = terminal voltage.
I_a = line current, which is assumed to be in phase with E_{ta}.
Ix_a = reactive drop in the armature due to reaction and self-inductance.
E_{ga} = the voltage which would be generated with the same field excitation on open circuit and corresponds in phase to the position of the poles.

If the terminal voltage on open circuit be assumed to be in phase with the pole position, under the load assumed it will have a lagging phase displacement

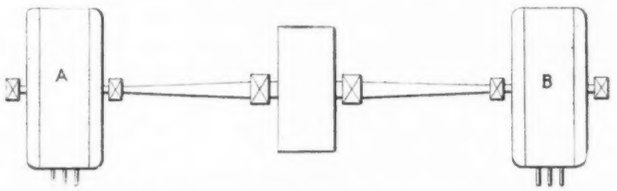


FIG. 1—MECHANICAL EQUIVALENT OF TWO ALTERNATORS IN PARALLEL

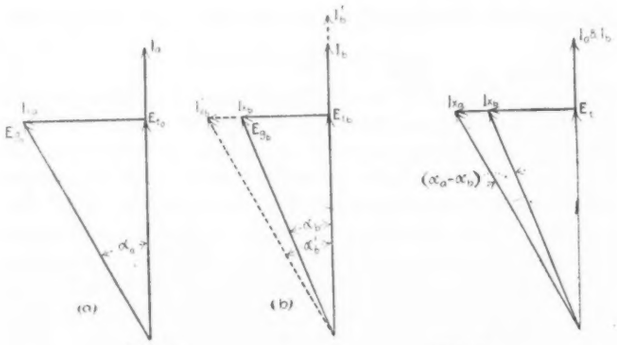


Fig. 2 Fig. 3

FIG. 2—LOAD DIVISION DEPENDS UPON INTERNAL VOLTAGE DROP.
FIG. 3—ANGLE OF STATOR SHIFT FOR LOAD DIVISION

behind the pole by the angle α_a. Ix_a and α_a will increase roughly as the load for a given power factor. It follows from this that in both generator and motor there are phase displacements with load which cause the terminal voltage to lag behind its relative open-circuit position for the generator and vice versa for the motor, and that this angle per unit load depends upon the inherent characteristics of the machines.

To show how these characteristics control the division of the load, compare diagrams (a) and (b) of Fig. 2. Equal loads are represented in the two cases. but the reactive effect and angle of displacement are considerably greater in (a) than in (b). Assuming that these diagrams represent the total effective char-

acteristics[1] for both motor and generator of each of two frequency-changer sets, *A* and *B*; when these are paralleled α_a must equal α_b, therefore the load on *B* must increase at a corresponding faster rate than that on *A* by the ratio of I_b/I_a. In other words, the load will divide in the ratio of the respective loads per unit of phase displacement.

This fact is of considerable practical importance, for in the design of a frequency-changer set required to operate in parallel with another, the inherent characteristics should be made to correspond with those of the other sets unless external means are used to obtain the proper distribution of load.

Consider for a moment the phase displacement of a 25-60-cycle set. Owing to the difference of the mechanical angle subtended per pole on the two machines, a displacement on the 25-cycle motor transmitted by the shaft to the 60-cycle generator will be increased by the ratio 2.4:1. Thus, if the motor has a displacement of 20 electrical degrees, this becomes 48 electrical degrees when referred to the generator, and if the latter has an added displacement of 20 electrical degrees, the total displacement will become 68 electrical degrees at the generator or 28.3 electrical degrees at the motor. From this it will be seen that the lower frequency machine at a set is the more effective in producing displacement for the whole set.

FIVE METHODS OF REGULATING LOAL DISTRIBUTION

This may be considered in two ways—first, a periodic or continual operation of some device to compensate for various conditions of the load; second, a permanent adjustment of the apparatus or auxiliary apparatus to make an average compensation over the working range of the machines in parallel. Some of the methods outlined below are applicable to one way, some to the other and one or two to both. The methods are as follows:

(1) Rotation of the stator of any machine about its axis.

(2) Angular change of the pole position electrically with respect to the rotor.

(3) Connection of a reactor in series with the armature of one or more machines.

(4) Use of an "out-of-phase" booster direct-connected to a set.

(5) Variation of the field excitation of any or all of the machines included in the sets.

LOAD DISTRIBUTION BY ROTATION OF STATOR

This method of load regulation is the one in general use at present and is employed in nearly every case in the manner of a permanent adjustment. The frame is constructed so that it can be moved through a small mechanical angle in a cradle formed by the frame feet. With the numerous synchronizing positions possible[2] it is not necessary to provide for a movement of more than from 4 to 6 mechanical degrees, and once the adjustment of the stator is made it is not expected to require any further attention.

Such an arrangement allows the variation of the phase angle of the generated, or open-circuit, voltage of one set with respect to that of another. If two sets have similar characteristics, this angular difference will be adjusted to zero; but if one set *A*, whose characteristics represented by diagram (a), Fig. 2, are more "drooping" than those of *B*, Fig. 2 (b), the stator of *A* must be advanced by the angle $\alpha_a - \alpha_b$, as is shown in Fig. 3, to get equal distribution at the load considered. The angle $\alpha_a - \alpha_b$ is constant regardless of the load, so that at no load or light loads there will be circulating currents flowing between the two machines. At greater loads than the one indicated the load on *B* will increase beyond that taken by *A*.

In certain detached cases frame rotation has been used for occasional variation of load distribution, the movement being effected by motor-driven worm gears.

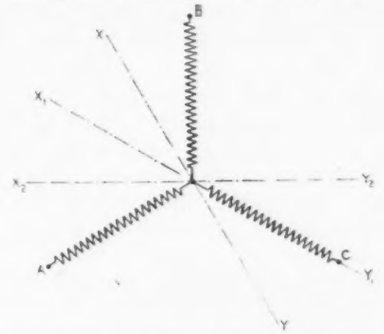


FIG. 4—SHIFTING OF POLAR POSITION

Thus the phase angle corresponding to $\alpha_a - \alpha_b$ can be varied as desired to suit the load conditions of the moment. Although such variation of load distribution is electrically desirable, this modification has not been used to any great extent, owing to the mechanical complications involved. Large forces are brought into play both when the auxiliary apparatus is in normal operation and, to a much greater extent, on occasions of short circuit where the frame must be held against abnormal torques produced by the short-circuit currents in the stator windings.

ANGULAR CHANGE OF POLE POSITION

If, instead of rotating the stator as in the last case, the angular position of the poles be changed with respect to the rotor, the same result will be accomplished. Consider this as follows: If a direct voltage be impressed on the collector rings of a wound secondary induction motor, we shall have, in fact, a synchronous motor with a distributed field winding: and if the direct currents in the various phases of the whole winding can be controlled to duplicate the instantaneous values of current of any period of a polyphase cycle, we shall have a motor in which the pole position can be revolved through any number of electrical degrees with respect to the rotor.

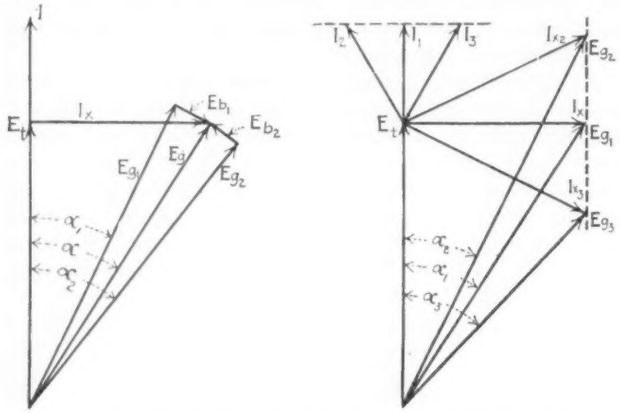
Let *A*, *B* and *C*, Fig. 4, be three terminals of a three-phase rotor winding, and let a direct voltage be impressed across the terminals *A* and *BC* (*B* and *C* being short-circuited), and the resultant poles will be along the axis *X*, *Y*. If the voltage be impressed across *A* and *B*, the pole axis will be X_1, Y_1. If the terminals *AC* and *B* be used, the pole axis will become X_2, Y_2. Thus by simply changing the terminals we can revolve the poles in steps of 30 electrical degrees. With the addition of rheostats the steps may be cut down as

[1] It should be distinctly understood that the term "effective characteristics" does not fully express the conditions to which it refers, for it assumes the total reactance of the two machines to be combined in the circuit of one machine and its voltage to be induced with its phase relation corresponding to the load current of that machine, whereas the voltages generated in the motor and generator circuits have different phase relations even when the power factors at the terminals of the two machines are the same. The term is only used here to avoid complications in explanations and diagrams.

[2] "Parallel Operation of Frequency-Changer Sets," F. D. Newbury, *Electrical Journal*, November, 1916.

small as desired, giving control of the voltage displacement relations of the armature over the entire range of angular position.

Such a method of control has certain disadvantages: For instance, the rotor with a distributed winding has inherently less space for the exciting winding than a salient-pole machine which necessitates a heavier and more expensive construction; it further requires a rheostat to handle a large portion of the exciting current. For these reasons the method remains, for the present at least, no more than a theoretical possibility.



FIGS. 5 AND 6—SYNCHRONOUS BOOSTER AND FIELD EXCITATION METHODS OF LOAD CONTROL

By connecting external reactance in series with one set its inherent characteristics may be changed and the desired load division secured. On examining diagrams (a) and (b) of Fig. 2 it will be noticed that if the armature reactance drop Ix_b were increased by a drop Ix_e in an external reactance of such a value that $Ix_b + Ix_e = Ix_a$; then for equal loads the effective reactive drops for the two sets will be equal and then characteristics will have been rendered similar by external means. As a corollary, it may be stated that it is immaterial whether the reactance be wholly in the generator or partly in the generator and partly external to it, as long as the total reactance is the same in both cases. Furthermore, if the reactance be made variable, the load distribution between two sets may be varied within certain limits.

To show roughly the effect of an external reactance, suppose two 25-cycle-60-cycle frequency-changer sets of similar characteristics to operate in parallel. For the same given loads the motors will have a phase displacement in each case of perhaps 20 electrical degrees, and the generators also have a phase displacement of possibly 20 electrical degrees at this load; then the total effective displacement in each case will be $20 \times 2.4 + 20 = 68$ electrical degrees on the 60-cycle end or 28 electrical degrees on the 25-cycle end. If a 10 per cent reactance be then added in one motor circuit, the displacement of this machine will increase from 20 deg. to 25 deg. and that of the whole set from 68 to 80 electrical degrees on the 60-cycle end. This will cause a ratio of load division of 54: 46, or a difference of 8 per cent of the total load. This rough calculation is worked out under the assumption of a load current at 100 per cent power factor. It will be understood that a change of power factor will modify such results to a certain extent.

Consider, now, the application of a direct-connected synchronous booster.

placing the booster rotor on the same shaft with the other machines of the set but with its poles displaced 90 deg. out of phase with respect to those of the machine whose voltage it is intended to modify. In such a case the excited booster will generate an out-of-phase voltage, producing an effect similar to that of reactance in series with the armature except that it may be either ahead or behind the main generated voltage and is always 90 deg. to it rather than to the load current.

A 15 per cent voltage booster will give a 8.5-deg. displacement of voltage either lag or lead, where, perhaps, 30 or 35 deg. corresponds to full load on the main machine; and if these values be applied to the motor of a 25-cycle-60-cycle set, the change of load distribution will be about 20 per cent in either direction.

The reactance of the booster armature windings will have the effect of increasing the reactance of the motor; it is, therefore, desirable to keep the inherent reactance of the booster fairly low. Fig. 5 represents the motor and booster diagram.

Ix = the reactance voltage for both motor and booster armatures.

E_g = the generated voltage with booster inactive; E_{g_1} with booster boosting and E_{g_2} with booster bucking.

E_{b_1} = the boosting voltage.

E_{b_2} = the bucking voltage.

α, α_1 and α_2 = the various displacement angles under the three conditions.

Thus with the load kept constant the displacement can be given the range of from α_1 to α_2.

One point of difference may be taken up here which applies both to this condition and that of stator rotation and change of pole position as compared with the series reactance. For a machine of given effective inherent characteristics the angular displacement will vary with the load, and the first group of methods will not change this, but simply a constant initial angle is added to or subtracted from the displacement according to the adjustment.

In the second case, or that of adding a series reactance (which also applies for the reactance of the

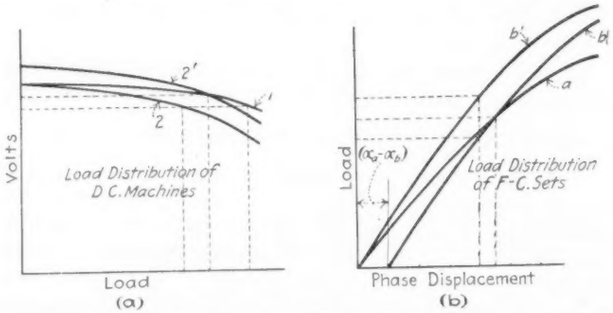


FIG. 7—LOAD DIVISION OF FREQUENCY-CHANGER SETS MAY BE ACCOMPLISHED AS WITH DIRECT-CURRENT GENERATORS

booster armature), the effective inherent characteristics of the machines or combinations of machines are changed; thus there will be a difference in the displacement angle for a given load regardless of any initial angular adjustment. Consider an analogy of two direct-current machines operating in parallel, of which the regulation characteristic curves are (1) and (2), Fig. 7. To change the distribution of load and increase the share taken by (2), some extra series field turns might be added to this generator, thus changing the

characteristics of the machine. This would be equivalent to subtracting some of the equivalent reactance of a frequency-changer set; in other words, the "droop" of the curve is actually changed.

On the other hand, the shunt-field amperes of generator (2) might be changed to give the regulation curve (2′). This is an adjustment which will give the average distribution required over a certain operating range, which corresponds to the first group or adjustment methods of load distribution control for frequency-changer sets. This type of control may be made as flexible as desired, but it will remain a means of adjusting a definite initial value and not a change of inherent characteristics.

CONTROL BY VARIATION OF FIELD CURRENT

To explain this method, consider the vector diagram of a synchronous motor, Fig. 6: E_t = the terminal emf. I_1, I_2 and I_3 = three different load currents, all representing the same amount of power. Ix_1, Ix_2 and Ix_3 = the three reactive drops corresponding to the three values of current. Subtracting these values from E_t, we have E_{g_1}, E_{g_2} and E_{g_3}, and the corresponding angles of displacement α_1, α_2 and α_3. Now the assumption for all cases is that the in-phase components of current (and the power) are equal; therefore it is shown that for a given torque the displacement of the motor can be varied by varying the field excitation. For instance, assume that the motors of two similar frequency-changer sets are to have a combined power factor of 100 per cent. One motor may be operated with a current relation of I_2 and the other of I_3, one lagging and the other leading by equal amounts so that the combined effect will give a power factor of 100 per cent. For equal loads the displacement of the two motors will be respectively α_2 and α_3. For a concrete example with 25-cycle-60-cycle sets, take $\alpha_2 = 20$ deg. and $\alpha_3 = 32$ deg., and take the displacement of either generator for this load to be 25 deg.; then the total displacements for the two sets will be respectively 73 deg. and 102 deg. at the 60-cycle terminals. Therefore, assuming that the power factors of the two motors are kept as indicated, the loads will divide roughly as 58 per cent and 42 per cent, or a difference of 16 per cent.

If care were taken to design machines with the object of this type of control in view—that is, with high reactance and large field excitation capacity—the limits for relative change of load distribution might be increased still more.

Generally speaking, there is little to be gained in applying this method to the generators of the sets as well as for the motors, for when the kilowatt load is decreased on one generator the kilovolt-ampere load increases in almost the same proportion. However, in the case of heating of the field windings of one generator, relief might be applied by transferring some of the magnetization to the other generator and keeping the same kilovolt-ampere distribution as before by an equivalent inverse transfer between the two motors.

Effect of Ranges on Distribution Layouts

Distribution Engineering Applied in a Community Where Every House Has an Electric Range Shows How This Load Can Be Handled Most Economically

By H. P. SEELYE
Distribution Department, Detroit Edison Company

THE rapidly increasing use of electric ranges has introduced a new consideration into the problem of secondary distribution, and one which may eventually predominate. In districts where gas is not readily available for cooking—as in rural communities, some small towns and certain sections of larger cities—coal ranges are rapidly being displaced by electricity. This is especially true of sections where the houses are all new and of the better class. In such places nearly 100 per cent range load may be expected as soon as the houses are occupied. In older sections the change is more gradual, a new installation being made here and there from time to time, although it is probable that eventually these districts also may approach 100 per cent.

On secondaries with residence lighting load only and no cooking load the density of loading ordinarily may range from zero up to 20 kw. per 1,000 ft. (304 m.) of line, being ordinarily about 15 kw. for a well built-up district of the better class of single residences or two-family flats. Where a few ranges are interspersed with a large number of lighting services the peak load will not be increased very greatly since the heaviest range load will come during the day when the lights are off and can be cared for by the installations provided for the lighting load. Of course, the peak is affected somewhat, since in the winter months during the lighting peak the range load will overlap for a short time. As the number of ranges increases they become an increasingly important factor in the total load. When all or nearly all of the services have ranges the distribution system must be designed for the range load primarily and lighting load becomes of secondary importance. The load density in such a case must be figured considerably higher than for the lighting only. The diversity factor for range load is high, owing to the variations in the time of using different ranges and in the number of elements used at one time on any one range. On some tests recently made the average load per service was found to be about 2 kw. per range for five ranges of about 5 kw. rating each. The average load no doubt decreases with an increase in the number of ranges considered. Probably from 1 kw. to 2 kw. would be a fair average load to assume, depending on the number of such services. This would give a load density of 40 kw. to 60 kw. per 1,000 ft., which is two to three times greater than for lighting only in similar districts.

In the older districts mentioned, where the range load is "spotted" here and there, each new installation must be considered separately. The secondary wire is already

in place and usually, especially when it is No. 4 or greater, it would be uneconomical to change it. In order to supply satisfactory service the transformer must be near enough to the range for good voltage conditions. It is impossible to make any general rules as to transformer spacing, as it is impossible to know when or where ranges will be installed next. Rules should be adopted as to the maximum distance allowable from transformer to range for each size of secondary considering the probability of there being other ranges in between. When a range is installed, if too far from a present transformer, a new transformer must be installed or an old one moved to care for it, providing at the same time for proper service to other neighboring ranges and to the lighting load as well. The size of transformer must also be adjusted to the change. In some cases it may be found economical to increase the size of secondary wire instead of installing an additional transformer. The economy of such a change should be determined, however, by a careful consideration of the annual cost of each type of installation, including the additional cost of making the change. It is seen that the problem in this case is one of providing satisfactory service for the individual load as it comes on rather than one of economical installation over a period of years to care for a general class of loading.

SPECIFIC PROBLEM ENCOUNTERED IN NEW COMMUNITY

Eventually in these older districts the range service will be frequent enough so that the load may be considered as uniformly distributed load of high density. This also is the condition met with in new sections as mentioned above. A good example of a problem of this kind was recently encountered and cared for as follows: A large manufacturer purchased a tract of land in the vicinity of his plant, subdivided it into lots 50 ft. by 125 ft. (15 m. by 38 m.) and proceedel to erect residences which he sold to his better paid employees, heads of departments, etc. As no gas service was available it was expected that practically every house would install an electric range. Such has since proved the case. The first section of houses built was in two blocks, each about 900 ft. (274 m.) long, or a total of 1,800 ft. (548 m.). The houses face on two streets with an alley between, giving, with 50-ft. (15-m.) lots, forty services 1,000 ft. apart, each pole carrying four services. The expected load was assumed as shown above to be 40 kw. to 60 kw. per 1,000 ft. In order to get an indication of the sizes of wire and transformers to be used, the problem was first attacked on a purely theoretical basis. The voltage was 220-110 volts, three-wire secondary. After comparing the annual costs on line transformers and energy losses, it was determined that the most economical size of wire would be, for a load density of 40 kw. per 1,000 ft., 54,400 circ.mil; for a load density of 60 kw., 66,600 circ.mil. No. 2 wire with a cross-sectional area of 66,370 circ.mil seemed to be the nearest available size. For No. 2 wire the most economical size and spacing of transformers would be: For load density = 40 kw., 31-kw. transformers, 784 ft. (239 m.) apart; for load density = 50 kw., 36 kw. transformers, 600 ft. (183 m.) apart.

It was decided that 25-kw. transformers spaced 600 ft. (183 m.) apart would be the best design, since an even spacing would be thus secured over the 1,800 ft. (548 m.) of secondary in question; that is, a transformer 300 ft. (91 m.) from each end and one-half way between. Since the full range load was not expected immediately, 10-kw. transformers were first called for in the two end positions with the center one omitted. As the load builds up the additional transformer and larger sizes will be added. This is sufficient to care for a load of 42 kw. per 1,000 ft. If the load goes beyond that, still larger sizes can be installed in the same locations.

This layout brings up two rather evident questions—first, as to the comparatively small size of transformer and short spacing for such load; second, as to whether a No. 4 wire would not be advantageous with such short spacing. In order to keep the voltage drop under 3 per cent, the transformer spacing must not be more than 825 ft. (251 m.) for 50-kw. density or 900 ft. (274 m.) for 42 kw. per 1,000 ft. on No. 2 wire. It was found that the annual cost of an installation of 50-kw. transformers at 900 ft. (274 m.) was about 15 per cent greater than 25-kw. units at 600 ft. (183 m.). No immediate size between 25 kw. and 50 kw. was available at the time. Likewise it must be remembered that a high diversity factor was used in determining the expected load. For good service the voltage conditions must be such as to care for the customer furthest from the transformer. With four services per pole the load transmitted to the farthest pole would probably be as high as 10 kw. at times. This would greatly reduce the spacing possible when the load is uniformly distributed. The same consideration would affect the use of No. 4 wire. If the load were uniform at 50 kw. per 1,000 ft., transformers could be spaced 680 ft. (207 m.) apart on No. 4 wire with 3 per cent drop. However, with No. 4 secondary and 25-kw. transformers, the savings in annual cost at 42-kw. load density is only about 2½ per cent, and it was considered more advantageous to obtain the better voltage conditions and greater adaptability to still larger loads by use of No. 2 wire rather than to save this amount.

The consideration of the economical aspects of such a problem involves the use of prices of copper, transformers, energy, etc., as they are at present. A change in those prices at some future date might give a somewhat different layout, but it has been found that a considerable variation would be required in order to affect the results. Moreover, the assumptions as to the character of heavy range loads may be considerably changed when more definite information is obtained as to the result of actual tests on such load. The building project which gave rise to the above problem is only the beginning of a program of considerable extent which when completed should be a fertile field for the study of such problems.

HEAVY RANGE DEVELOPMENT MAY CHANGE DISTRIBUTION STANDARDS

It is easy to see that if the use of electric ranges becomes anywhere near universal in urban districts, present standards of distribution must be revised considerably. Larger sized secondaries will be called for than are generally used for lighting load. Probably a greater variety of large transformer sizes than are now necessary on any system will be found advisable, and the whole system of transmission feeders, etc., will have to be adapted to the heavier load. The effect on the load of the central station as a whole would be somewhat like that of a large additional power load with a comparatively low load factor.

An Analysis of Insulator Practice—II

Based on Reports from More than Forty Transmission Companies—Nature, Frequency and Expense of Tests and Inspection—Observed Causes of Failure with Discussions Regarding Principal Ones

THE type and rating of insulators used by more than forty transmission companies on lines operating at 13,000 volts to 150,000 volts were presented in the last issue of the ELECTRICAL WORLD with explanations regarding the operating conditions which determined the practice. In the present issue, information will be given regarding the nature, frequency, expense and effectiveness of insulator tests and inspection, and each company's report regarding observed causes of insulator failure and their remedies will be presented. Particular attention will be given to dead-end failures, effect of alternate exposure to heat and cold, deposits of dust and salt, effect of position of disk in string, preventing injury from arc-overs, use of ground wires, and ratio of puncture to flash-over voltage.

To facilitate comparison, the practices of every company in connection with each subject considered will be discussed as a group. Space does not permit repeating company names so that the key numbers given opposite the companies listed in the last issue are substituted.

Surprising to say, less than 50 per cent of the companies reported make any preliminary tests on their insulators before placing them in service or test them periodically after they have been in operation. Preliminary tests are probably omitted by some either because they are satisfied with the factory tests made by most insulator manufacturers or because the operating companies are not equipped to conduct any more conclusive tests than the factories. Some companies have a representative supervise the factory tests. Tests after the units have been in the service are omitted by some because visual inspection is considered sufficient. Besides, the causes of insulator failure have been almost purely hypothetical so far, and few knew exactly what tests would give information of value. In addition there had been few test methods developed until recently which could be conveniently and effectively used by operating companies outside of a laboratory. Pin insulators are not tested so much as those of disk type, company 38 specifying them according to the recommendation of Messrs. Cunningham and Klauber at the Del Monte (1918) convention of Pacific Coast Section of the National Electric Light Association.

To companies which are not satisfied with their present test method or those which have not adopted any the following résumé of practices may be of value:

Preliminary Tests.—Various methods of making preliminary tests are employed, namely flash-over (wet and dry) at normal frequency, megger, "buzz stick" (see ELECTRICAL WORLD, Sept. 13, 1919, page 1012), Keokuk testers (see ELECTRICAL WORLD, Dec. 6, 1919, page 568), oscillator, puncture test, equivalent porosity test, hot and cold test, etc. Flash-over and megger tests are in predominance, the first being used by companies 14, 20, 24, and 35, and the latter by companies 8,[1] 11A, 15,[4] 21,[2] 30, 32,[3] 34, 35 and 40[6]. The Keokuk tester, "buzz-stick," oscillator and special tests for porosity, puncture and effect of alternate hot and cold are about equally divided among the companies reporting, although the first two methods are so new that they have an opportunity to outclass the others, which have not been adopted more extensively despite the fact that they have been known for some time. These four methods are used by companies 15, 31,[9] 33, 36 and 11 respectively.

Company 1 subjects its insulators to a voltage just under the flash-over value at 60 cycles for five minutes; company 38 subjects insulators not given a factory test[7] to 50-cycle high potential (about 90 per cent of flash-over) until no insulator under test fails during a two-minute period; company 14 occasionally tests at 25 cycles for wet and dry flash-over, and company 20 subjects insulators to dry flash-over at 60 cycles after the units have been soaked in salt water and wiped. Company 30 discards all insulators measuring less than 2,000 megohms, and 33 inspects all insulators for cracks and deformities, using an oscillator at 70 kv. or 20 per cent below flash-over for random samples. Flashing over with an oscillator is believed by company 33 to injure insulators, although company 36 does so for five seconds. Two companies, 12 and 37, have their units of the 66,000-volt class tested by the Electrical Testing Laboratories before installation. In addition company 37 applies normal voltage and frequency. Another company, 14, makes no systematic tests but occasionally picks out ten or a dozen insulators at random and tests their wet and dry flash-over values and observes breakdowns. The routine tests carried out by several insulator manufacturers and relied on by 50 per cent of the operating companies involve a five-minute normal frequency flash-over test, physical inspection to detect cracks and mechanical pull to eliminate defective cementing. Some manufacturers employ a high-frequency test or even combine it with a normal-frequency test. Megger tests are also made by some manufacturers.

Tests After Installation.—For testing the condition of insulators after they have been in service, the following methods rank in the order named as to extent of use: Megger, 8,[5] 9, 11, 11A,[14] 12, 14,[5] 21, 27,[10] 30,[11] 34, 35, 38,[13] and 40; "buzz stick," 1, 5, 7, 8, 11A, 20, 21,[13] 29, 31; Keokuk tester, 14,[12] 15, and 32;[12] telephone receiver, 30 and 39; oscillator, 33; wireless telephone set, 7. With the megger, company 8 tests disks twice yearly

[1]Failures do not exceed 0.1 per cent between factory and towers.
[2]Will use in future.
[3]Only for 110,000-volt insulators.
[4]One per cent of insulators subjected to this test.
[5]Immediately after installation.
[6]For suspension insulators; pin insulators tested at voltage just below flash-over; megger must show 2,000 megohms with fairly favorable surface conditions.
[7]Suspension insulators of the 10-in. disk variety are given rigid factory tests and inspection according to this company's (38) specification No. 300 under the supervision of a company representative. The operating company believes it is better to incur this expense at the factory, even to the extent of destroying some units, than it is to have insulators of poor quality installed on the lines.
[8]Formerly used.
[9]For experimental purposes.
[10]Not found practicable.
[11]Disk insulators below 2,000 megohms are discarded.
[12]Being investigated.
[13]Patterned after Keokuk tester.
[14]Until last year.
[15]Several other methods are being tried; with the older suspension insulators the defective insulators found by megger test range from one-half of 1 per cent to 29 per cent of the total; with suspension insulators purchased in the last three years the defective insulators found by megger test are almost negligible.

THE WASHINGTON WATER POWER CO.

Weekly Report .....Patrolman.

.....Station from Sunday.....191..to Sunday.....19..

	State of Weather			Temperature		
Day	7:00 A.M.	Noon	8:00	7:A.M.	Noon	8:00 P.M.
Sunday						
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						

Patrolled
From Pole No. To Pole No.

Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

Condition of Pole Line (Including broken insulators and signs on poles)

Condition of Substation

Supplies and Apparatus Received

Material Used: (State amount and where used)

REMARKS:

REPORT OF PATROL OF HIGH TENSION LINES
ALABAMA POWER COMPANY

REPORT NO.

MONTH OF POLE AND TOWER LINES LINE SUPERVISOR

DIVISION HAZARDS REPORTED DATE

Line From	Section to	Date of Patrol	Name Patrolman	Defective Insulators No.	Job No.	Line Wires No. Cases	Job No.	Structure Hazards No.	Job No.	Timber Hazards No.	Job No.	Remarks

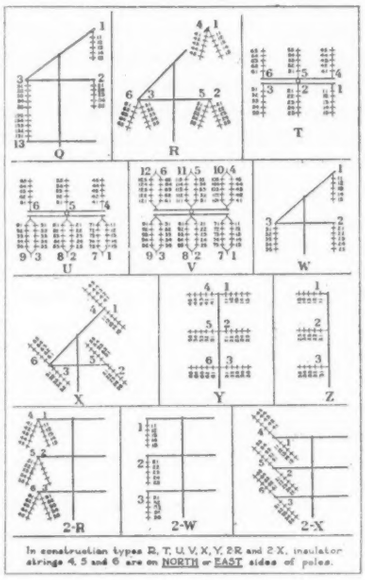
SAN DIEGO CONSOLIDATED GAS & ELECTRIC COMPANY
INSULATOR TESTS, FAILURES AND RENEWALS

POLE NO. TYPE

ENTRIES TO BE MADE BY LINEMAN (Number reported line for each insulator)			ENTRIES TO BE MADE BY TESTER (After insulators are cleared)			
POSITION REPORTED	TYPE SET	TYPE CHANGED	FLASH CO	INSULATOR PUNCTURED	CONDITION	DISPOSAL MADE

DATE OF FAILURE OR CHANGE CHANGED BY

CAUSE OF FAILURE AND REMARKS:



In construction types R, T, U, V, X, Y, 2R and 2X, insulator strings 4, 5 and 6 are on NORTH or EAST sides of poles.

INSPECTION AND TROUBLE REPORT

TO BE MADE BY PATROLMAN, LINEMAN, FOREMAN, OR OTHERS, AT

....., 19...

Time trouble occurred.....

Time you went on line.....

Time you reported off line.....

Name of line or circuit.....

Number of tower or towers.....

Number of pole or poles.....

Type of Tower—Strain, Suspension, or Switch.....

Kind of pole, what b[illegible] of wood.....

Insulator—Give number or position on pole or tower.....

Were insulators broken, punctured, shattered, shot? Describe which?.....

If on yoke, name inside or outside string, and give numbers of insulators.....

Cross Arms, which one—left, top, or right?.....

What caused the trouble?.....

Were any of the wires burned in two, and whether at pole or.....

Were any of the wires burned in two, and whether at pole or tower, or in span?.....

Any telephone trouble, and what was it?.....

Did you report this full information to Charlotte; if not why not? This must always be done.....

If your line is O. K. this week write on this line ONLY.....

Also sign your name on this line.....

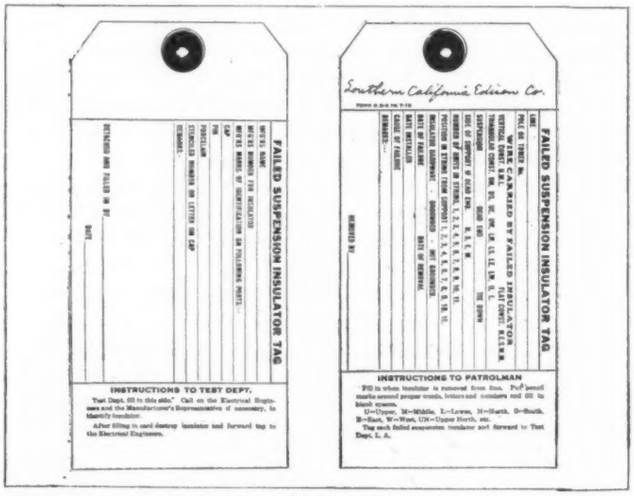
Draw sketch on back of this report, if necessary, and mail in to F. D. Sampson, Charlotte, N. C., not later than Friday, or, in case of trouble, the same day as you fit up trouble.

PUGET SOUND TRACTION, LIGHT & POWER COMPANY
SEATTLE DIVISION
TRANSMISSION LINE PATROLMAN'S REPORT

Report of Patrolman for Week Ending 191...

This report must be filled out at the end of each week and mailed to the superintendent's office. Note where railroads, fences or buildings are going up near line, or anything affecting the system in any way. Give number of insulators replaced, telephone [illegible] pole and details of all necessary repairs, giving location and pole numbers. When removing insulators replaced state reason for changing, and state exactly which insulator on the pole top was changed. The insulators may be designated as right or left cross arm insulator looking along the line in the direction of increasing pole numbers, and in case of double arm construction, it should be stated whether on north or far cross arm. On steel towers cross may be designated as top, middle and bottom arm. A separate and detailed report should be made on the reverse side of this sheet of all special work such as line trouble, fires, washouts, poles set or moved, stump blasting operations, etc.

Date	Line Patroled or Switch Examined	REPORT OF CONDITION AND DETAIL OF REPAIRS



A—SAMPLES OF TRANSMISSION COMPANIES' REPORTS

Left top—Weekly report used by Washington Water Power Company. Left bottom—Inspection and trouble report of Southern Power Company. Right top—Method of reporting line hazards on Alabama Power Company's system. Below are: Opposite sides of report form on insulator tests, failure and renewals used by San Diego Consolidated Gas & Electric Company; transmission-line patrolman's report used by Puget Sound Traction, Light & Power Company; opposite sides of tag used by Southern California Edison Company for faulty insulators.

with the line dead, and 9 and 38 yearly and sometimes twice or three times on bad sections; company 12 tests its 66,000-volt lines with this device. Company 10 does not consider insulators good unless they megger 5,000 megohms when dry, while company 38 says that a megger will satisfactorily pick out cracked insulators after a rain but not so well after a long dry period. No testing of pin-type insulators has been found more practicable by company 9 than to replace all units after maintenance becomes excessive. The removed insulators are subjected to flash-over voltage two to five minutes to weed out bad units, and serviceable ones are re-installed. Other companies remove a quantity of pin insulators after trouble becomes excessive and test the flash-over after meggering. If general weakness is observed, the remainder of the insulators of the same age are removed and tested. Company 29 merely inspects them visually, with the line dead, once a year, whereas company 40 tests them with a small spark coil. Live-line testing is permitted by the "buzz stick," companies 5 and 7 testing 66,000-volt suspension insulators in this way; 8 all disks twice yearly, and 31 yearly and sometimes oftener. The Keokuk tester is used with the line "dead" and is found particularly serviceable at night or when insulators are moist. Company 32 expects to use a device similar to the Keokuk tester for its 110,000-volt line this spring. The telephone receiver is used by companies 30 and 39, with lines "alive," for testing pin-type insulators. The test set employed by company 39 consists of a 2,500-ohm wireless receiver connected in series with a wire leading from the lineman's spurs to a sharp metal point on the end of a bamboo pole. The inspector, standing on the ground, thrusts the sharp metal point in the line pole some distance above the ground; a leaking insulator will disturb the normal hum in the receiver and produce a scratching noise. The defective unit can be located by touching the metal point at different points along the cross-arm. An oscillator test is made every two years by company 33, after visual inspection. Although the megger is rather erratic in detecting faulty insulation, the oscillator will indicate a fault whether the unit is wet or dry. The wireless telephone method will be used by company 7 for 13,200-volt and 33,000-volt lines.

Frequency and Method of Inspection

Despite the fact that testing of insulators by operating companies is the exception rather than the rule, practically all inspect the units during service, some more frequently than others. The intervals between inspections range from one day to one year, although two companies (32 and 35) have no fixed period. The most frequent inspections are made on highly important lines, whereas infrequent ones apply to the less important lines, or those on which so little trouble has occurred that inspection is not considered essential. If the lines are along highways frequently traveled by men in discharge of duties, no patrol other than this is made by company 40. On the other hand, some sections of line not otherwise under observation may be patrolled as often as once a week, although the practice of company 40 during the past few years has been to reduce the frequency of patrol and lay more stress on a special inspection by men of greater responsibility than the average patrolman. Patrolmen report defects to the nearest switching station by telephone, and arrangements are made for their elimination through the load dispatcher's office. As practically all the transmission lines of company 18 parallel the company's interurban track, insulator inspection is made by division foremen having charge of overhead as well as transmission lines. These men are supposed to remove a defective insulator immediately if conditions are such that the line can be cleared. Testing and inspection are combined by some companies, 31 for example, whereas others employ visual inspection assisted by field glasses, the inspector walking, or riding on horseback or in an automobile. One company (36) reports that it detects some of its faulty insulators by the noise which they make. Watchman's time clocks are used by company 4 to insure regular inspection. On company 20's system each patrolman inspects 25 to 50 miles of line continuously.

Weekly inspections are in the majority, being adopted by companies 1, 2, 5,[9] 11A, 12,[10] 14,[11] 16,[12] 17, 19, 24, 29,[13] 30 and 36. Bi-weekly inspections rank next, being made by companies 3, 4, 6, 7, 10, 11, 15, and 16.[14] Inspections are made about every three weeks by company 39, the frequency depending on the importance of the line and whether city or suburban. In addition the "telephone" test mentioned in the preceding paragraph is made one to three times a year. Bi-monthly and monthly inspections are equally divided, the first being employed by companies 8, 22 and 33, and the latter by 21, 23 and 33. Daily inspections of 66,000-volt lines are made by company 5, whereas company 12 inspects its lines every day or two. Ten-day intervals are maintained by company 34, quarterly ones by 31 and yearly by 9[15] and 31. Special patrols are made after severe storms by 9 and 19. Occasional inspections at no regular intervals are made by company 3[16] which observes them from the ground. Anything unusual is telephoned to headquarters and later embodied in weekly reports.

Periodic tests and inspections of insulators enable most of the companies to remove from two-thirds to all of their faulty insulators before total breakdown occurs. These reports are based on the ratio of the number of insulators removed before total break-down to the total number that have to be replaced. Six of the companies (3, 12, 20, 21, 22 and 32) report that none or a very low percentage of insulators are removed before breakdown. Of 3,000 pin-type insulators replaced by company 29, twenty were removed after failure and 2,980 before failure. Of 2,000 link-type insulators replaced, twenty-two were replaced after failure and 1,978 before failure. During 1919 the suspension insulators involved in failures on company 38's system, including those removed by megger tests, amounted to 0.06 of 1 per cent of those in service. Many of these were undoubtedly good until destroyed by the failure of one or more other units of the same string. The number of failures was eighty-two, while the number of units destroyed was 286. Nearly all of them were of the older types.

Testing and Inspection Expense

The cost of testing insulators ranges from 0.8 cents to 18 cents. Leaving out the extremes, which are far from the average, the expense averages 7 cents a disk.

[9] 22,000-volt and 33,000-volt lines.
[10] 13,200-volt lines.
[11] Or monthly.
[12] Two or more times yearly in bad sections.
[13] Tests all link-type insulators yearly with buzz stick.
[14] Lines along interurban track are inspected by line repairmen; broken insulators and line defects are reported by trainmen, section men, etc.
[15] Lines removed from interurban lines.

A better appreciation of the cost of testing and inspecting insulators can be gained by studying the following compilation and comparing with the operating conditions and methods of test reported:

(1) One and one-half cents per insulator per year for testing.

(8) Eight cents per disk per test, 12 cents per disk per year for inspection.

(9) Eight cents per disk per year for testing eight-unit strings in suspension and ten-unit strings in strain (includes meggering good and bad and replacing faulty ones).

(11) Six hundred and eighty man-hours labor a year for testing 12,000 disk units and locating about 1,200 bad ones (work conducted by four crews, each consisting of patrolman and helper); time includes actual working hours and time lost in taking circuits out of service and restoring service; 640 man-hours per year replacing 1,200 insulators; 160 man-hours per year to and from storeroom.

(11A) $2 per defective unit to test and change defective insulators.

(20) Five and one-half cents per insulator per year by buzz-stick method, testing on tower lines.

(21) $2,280 on 120 miles of high and low-tension line a year.

(29) One and one-quarter cents per insulator per year for testing and inspection respectively.

(30) One and two-tenths cents per unit per year meggering; 7 cents per unit per year inspection.

(31) Eight-tenths of a cent per unit per year testing.

(33) Eighteen cents per disk per year for oscillation tests on 60-kv. tower lines; 10 cents per unit for inspecting pin insulators. The patrol cost per mile of line averages: 11 kv., $6.84; 22 kv., $8.18; 33 kv., $8.34; 60-kv. pole lines, $8.56; 60-kv. tower lines, $8.70.

(34) Six cents per unit per year testing; 12 cents per unit per year replacing.

(39) Ten to 20 cents per unit per year for testing 55,000-volt insulators; approximately 15 cents for inspection.

(X) Eight cents per insulator per year, testing twice.

(36) The cost of testing 75,000 units which had been in service, including the expense of testing and handling 23,000 new units required to replace faulty ones and the labor of testing and handling 15,000 additional units that were added to existing strings, amounted to approximately $25,000. This covered engineering, superintendence, automobile expense and labor—everything but cost of new units. The testing was not done with insulators in place. Instead all insulators were removed from towers and hauled to test camps established along the line about 10 to 15 miles (16 to 24 km.) apart. This method was more expensive than ordinary methods, but had the advantage that it allowed bad units to be changed immediately, and eliminated the necessity of a follow-up crew.

PROBABLE CAUSES OF FAILURE

Such variant answers have been received in reply to the question of "What are the observed probable causes of failure and how do they rank in importance?" that it is difficult to give the consensus of opinion. However, it may be pointed out that temperature changes and differences in expansion of insulator parts, malicious damage by hunters, boys, etc., surges due to line conditions, and lightning, were cited most often by twenty-seven companies in the order named. Porosity of porcelain, absorption of moisture, short-circuits by birds, squirrels, etc., deterioration of finish, dust and salt, and horizontal position of strain insulators were also given as observed causes. Very few believed that failures were due to electrical stresses.

Some companies classify the causes of insulator failure and give them relative weights as follows:

(1) Temperature changes, 90 per cent; lightning, 9 per cent; miscellaneous, 1 per cent.

(4) Lightning, 50 per cent; hunters, boys, etc., 50 per cent.

(5) Lightning, 90 per cent; mechanical, 10 per cent.

(16) Hunters, 80 to 90 per cent; temperature changes and line surges, 10 to 20 per cent.

(23) Hunters, 80 per cent; cracks, soft porcelain and improper ties, 20 per cent.

(24) Hunters, 60 per cent; lightning, 30 per cent; miscellaneous, 10 per cent.

(31) Porosity, 95 per cent; miscellaneous, 5 per cent.

(35) Line conditions, 90 per cent (dust, salt and fog); cleaning greatly reduces.

(37) Lightning, 75 per cent; rifle shots, 20 per cent; miscellaneous, 5 per cent.

Since the reported causes of failure in different parts of the country may influence the insulation of future lines or re-insulation of old ones in the same territory, the causes reported by other companies are given below in order of importance:

(2) Flash-over due to surges (sectionalizing reduces); puncture at head of pin on metal arms.

(3) Short pins allow birds to short-circuit conductor; hunters shoot at insulators.

(6) Mechanical stresses on long spans.

(7) Temperature changes; moisture absorption; hunters.

(8) Temperature changes.

(9) Spongy soft porcelain corrected by firing at higher temperature; differences in expansion of steel, porcelain, etc., corrected by cushioning.

(10) Mechanical; pin insulators on steel arms damaged by power arcs following spill-over.

(11) Temperature changes; porosity; power arcs.

(11A) Absorption of moisture and cracking.

(12) Temperature changes.

(14) Deterioration of finish and porosity of porcelain in pin insulators; absorption of moisture by cement in disks.

(19) Lightning, hunters, etc.

(20) Surface cracks.

(21) Electrical causes, rain and sleet causes flash-over on horizontally strung units, hunters, and possibly increased strain at dead-ends. All failures except those due to malicious damage have occurred on the 66-kv. line between Twin Falls and Iron River, Mich., within 11 miles (17.6 km.) of Iron River substation. Trouble began (1915) three years after the line was built and increased rapidly. The remainder of the line, 25 miles (40 km.), has not had a single puncture in six and one-half years. The trouble does not seem to be affected by the type of insulator used but rather by the location. No insulators have had to be replaced on Stager-Alpha line in four and one-half years.

(29) Flash-over due to lightning, puncture by lightning, flash-over due to surges, punctures due to surges, flash-over due to malicious interference such as throwing stones and shooting, and manipulation of clay in plastic state.

(30) Cracks, absorption, mechanical injury, flash-over.

(32) Flash-overs.

(33) Porcelain and design of insulator.

(34) Temperature changes (top insulators affected most).

(36) Mechanical design; examination of faulty insulators indicates that weak spots are in the side wall of insulator head opposite end of pin. Use of paraffin, felt or paper washers, and other easily compressed materials between parts having different expansion coefficients has helped alleviate troubles considerably.

(38) Faulty design and manufacture of early types indicated by minute cracks evidently caused by unequal expansion and contraction of parts; newer types are giving excellent results.

(39) Poor porcelain, mechanical damage such as falling trees, blasted stumps, thrown rocks and rifle shots.

(40) Porosity of porcelain with subsequent absorption of moisture and reduction of insulating value; cracking of porcelain due to different rates of expansion of attached metal parts; cracking of porcelain in pin types due to expansion of the cements or sudden contraction of the outer parts caused by rapid cooling (both of these causes would produce the same results so it is impossible to determine which is the cause, although some evidence points to more rapid cooling of the top part of the insulator); some failures have resulted from cracking due apparently to internal stresses in the porcelain.

(X) Temperature changes.

How Meter Installation Tests May Be Reduced*

On Small Induction-Type Meters Installation Tests Are Not Necessary, and Periods Between Routine Tests Should be Longer

BY R. A. KELLER

WITH the improvements in meter construction, particularly the induction type, there has arisen the question of eliminating certain installation tests and lengthening the periods between routine tests. It is common practice to test and adjust all meters as they are being sent out for installation, and it is thought that the test after setting up the meter is usually an unwarranted additional expense in the case of single-phase induction-type meters of capacities up to 25 amp. A majority of state utilities commissions set sixty days as the limit for making tests after installation. Some give thirty days. The table below shows the accuracy of 2,473 meters tested at installation by the Central Illinois Light Company during eight months of 1919:

Per Cent of True Reading	No. Tested 2,473	Total Per Cent 100.00	Per Cent of True Reading	No. Tested 2,473	Total Per Cent 100.00
Not recording	24	0.97	99 to 100	628	25.40
Under 80	11	0.45	100 to 101	738	29.80
80 to 90	9	0.36	101 to 102	388	15.70
90 to 95	37	1.50	102 to 103	158	6.40
95 to 96	19	0.77	103 to 104	44	1.78
96 to 97	32	1.40	104 to 105	9	0.36
97 to 98	96	3.90	105 to 110	19	0.77
98 to 99	258	10.40	110 to 120	3	0.12

The cost of making these tests was $1,181.78, an average of $0.48 per meter.

Data from several companies showed that 1.2 to 5 per cent were over 4 per cent slow; 2.8 to 3 per cent were 2 per cent to 4 per cent slow; 4.3 to 8.1 per cent were 2 per cent to 4 per cent fast; 0.5 to 1.2 per cent were over 4 per cent fast.

From these tables the loss in kilowatt-hours which should be measured amounts to about 0.5 per cent to 1 per cent of the total reading. These tests cover all classes and sizes of meters.

The Central Illinois Light Company serves twenty towns in a radius of 35 miles (56 km.) operating 21,500 meters, 19,000 of which are single-phase and under 25 amp. capacity. This company believes that commutator or mercury-type meters and large-capacity alternating meters should be tested at installation, but from the foregoing figures it is thought that on the 5-amp. to 25-amp. induction meters installation tests are unnecessary and uneconomical. Another Illinois company stated that installation tests are unnecessary and amount to 20 per cent of their cost of meter testing.

A contrary opinion held by a large company of the state is that any saving effected would be counteracted by loss of revenue and that the salary of an inspector must be paid to comply with the rest of the requirements. However, the figures in this article show that the revenue loss is small and the meter setter can satisfactorily meet the inspection requirements.

One Illinois company is eliminating installation tests by leaving the meter in the house and cutting the service wires at the pole. With the safety entrance switches this method could probably be used to advantage by locking the boxes.

In regard to the periods of routine tests the commissions differ as shown in the lower table.

The requirements of the State of Illinois in this respect are more complete and in much more detail than those of some other states and are more nearly a standard of practice, with the exception that small capacity induction meters should have the test period materially increased.

The following table shows the results of routine tests of all types and sizes of meters by the Central Illinois Light Company:

Per Cent of True Reading	No. Tested 4,614	Total Per Cent 100.00	Per Cent of True Reading	No. Tested 4,614	Total Per Cent 100.00
Not recording	34	0.74	99 to 100	887	19.3
Under 80	68	1.5	100 to 101	642	14.0
80 to 90	82	1.	101 to 102	494	10.7
90 to 95	202	4.4	102 to 103	233	5.0
95 to 96	176	3.8	103 to 104	83	1.8
96 to 97	279	6.0	104 to 105	23	0.5
97 to 98	613	13.3	105 to 110	16	0.35
98 to 99	779	16.9	110 to 120.	3	0.06

The company believes that the schedule shown here is correct for direct-current meters and the older type of alternating-current meters. It is desirable to test direct-current meters at least once a year, and large customers' meters are tested every six months or every three months because a small error represents a large amount of money. But for the 5-amp. to 25-amp. induction meters an increase in the period between tests should be allowed, some companies believe to four years or even five years.

One Illinois company makes the statement that, owing to war difficulties, periodic tests in a town of about 500 meters were discontinued for five years. When resumed the meters were found to be about as accurate as at the end of a thirty-month period. Manufacturers' laboratories have found that a variation of only 2 per cent was recorded for from 10,000,000 to 16,000,000 revolutions of the disk, representing probably ten years' use.

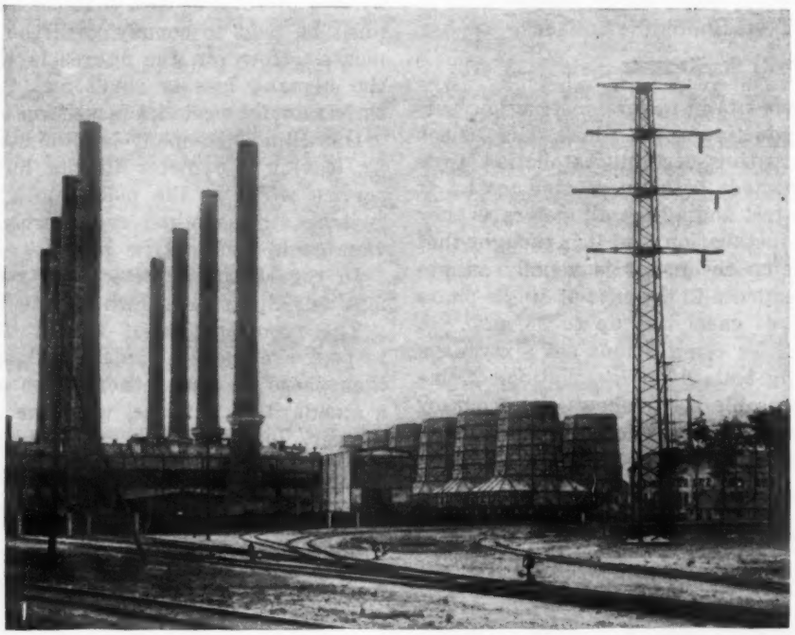
PERIODS BETWEEN TESTS—MONTHS

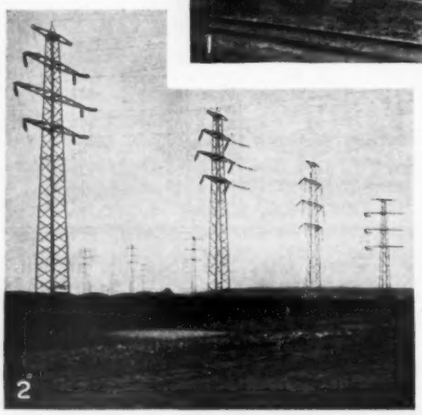
States	Single-Phase, Two and Three-Wire			Polyphase, Self-Contained		—Commutator and Mercury Type—			
	5–25 Amp.	5–50 Amp.	Over 25 and 50	To 50 Kw.	Over 50 Kw.	5–15	5–50	50 to 500	Over 500
Illinois	30	..	24	18	12	..	18	12	...
Missouri	..	24	12	..	..	..	12	6	...
Colorado	36	..	24	24	12	24	18	12	...
Indiana	36	..	24	18	12	..	18	12	...
New Jersey	30	..	24	24	12	..	18	12	6
Ohio	..	..	..	..	..	..	..	..	...
Connecticut	36	..	24	18	12	..	18	12	...
Wisconsin	48 (Code)	..	..	..	..	..	..	..	...
District of Columbia	24(non-code)	..	..	..	..	..	..	..	...
	36	..	24	24	12	..	18	12	8

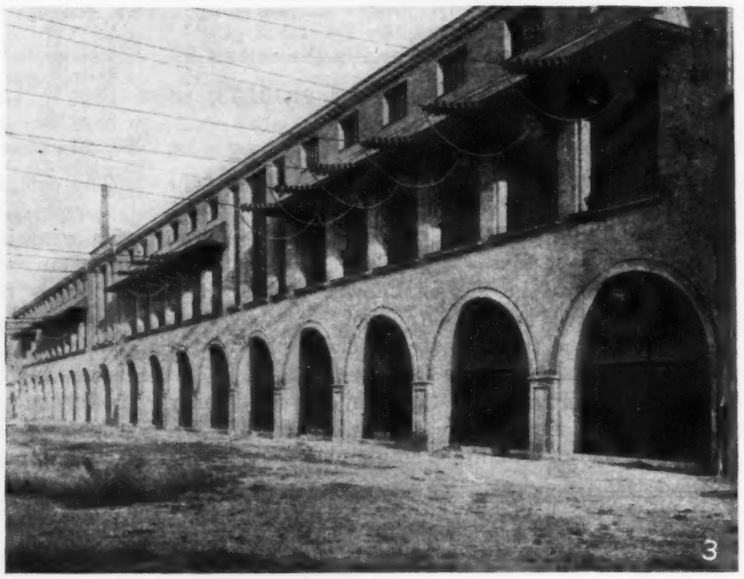
*From a paper read before the Illinois State Electric Association, Chicago.

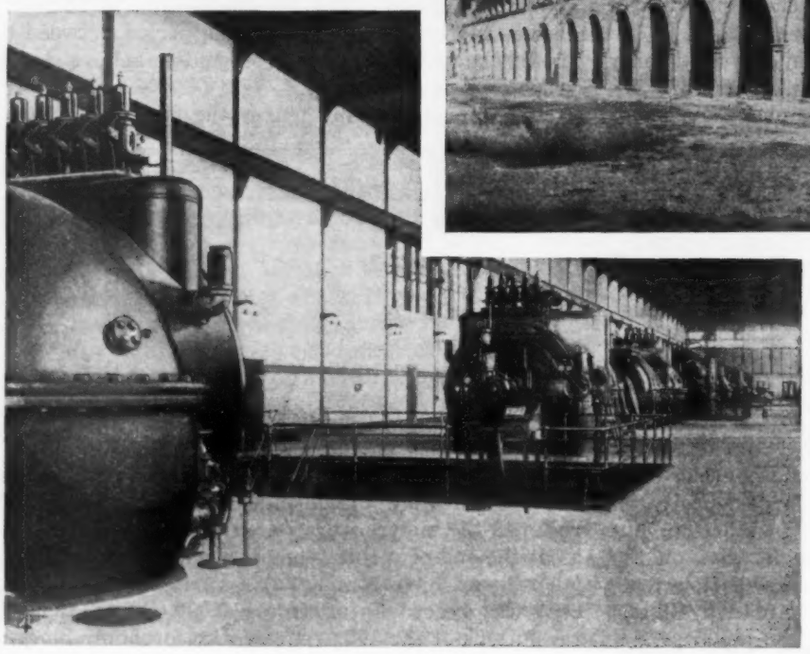
Mammoth Generating Station Serving Berlin

DURING the World War the long-cherished plan of the late Emil Rathenau (the German Edison) to supply the city of Berlin with light and power from a station located in the heart of the lignite coal country was put into effect. This mammoth generating station is situated 120 km. southwest of Berlin and is capable of developing 128,000 kw., which is more than twice the light and power demand of the German capital.









No. 1—General view of 160,000-hp. generating station showing eight chimneys which serve sixty-four 8,000-sq.m. boilers and cooling towers for condensing water.

No. 2—Transmission line carrying energy to substation in suburb of Berlin.

No. 3—Some of the outgoing high-tension lines.

No. 4—Eight steam turbines rated at 16,000 kw. each are installed in this turbine hall.

Electrical Research Needs Strong Support

The Whole Electrical Field Should be Studied and Indexed to Guide Research Effort — Training Research Workers a University Function — Lessons in European Methods Should Not Be Overlooked

By VLADIMIR KARAPETOFF
Professor of Electrical Engineering, Cornell University

WHEN a rich new gold field has been discovered one would hardly expect the adventurous first settlers to do any careful surveying of the region. Digging is good almost anywhere, and who wants to waste valuable time for something uncertain? It is only later when gold becomes scarce that more systematic mining is resorted to and surveys are made.

A similar situation arises from time to time in this or that branch of science after an epoch-making discovery. At first the results of this discovery are viewed with some incredulity; then comes a rush to cover the most salient points, and finally a gradual withdrawal to more promising fields. In time there comes another patient group of scientists content to do the mining in abandoned workings of the pioneers. Finally the field becomes a common playground from which no one expects much, although every one is using it.

In some branches of the electric theory and applications we seem to be now at just such a stage of development, when the most brilliant minds have lost their interest in some topics and have turned their attention elsewhere. Perhaps the subject of electrical power machinery is illustrative of the situation. Further increase in size, better cooling and other such problems have been left to regular designers who in their modesty do not claim to be geniuses. The familiar names of those who have originally brought the electrical machinery to the present stage of perfection are now found under investigations of an entirely different kind.

Gaps in Our Present Electrical Knowledge

In these comparatively old workings abandoned by the pioneers it is time to make a survey and to take an inventory of what we have, what we need to know, and how to obtain it. The co-operative researches on core loss and on insulation recently organized under the auspices of the reorganized Council of National Research may be cited as an example. Probably the minds of the first magnitude in science cannot be interested in such an undertaking, except out of politeness, in an honorary capacity. Nevertheless, much good will undoubtedly result to the profession at large. Who knows, perhaps the large volume of carefully compiled data will lead to a new bold generalization in the mind of a future genius, and a new scientific cycle will be started with wonderful horizons and applications. Thus, some centuries ago, certain discrepancies between theoretical and observed astronomical data led to the boldest speculation of all times, that concerning the finite velocity of light.

What we need is a carefully prepared and exhaustive list of research problems and of the lacking data in the principal branches of electrical science and engineering. The field is so large that all our engineering societies with their numerous committees could work on it for years without interfering with each other. In the meantime groups of workers should be organized to fill at least some of the most flagrant gaps in our knowledge. This will give a useful outlet to wasted energies of many capable and willing workers who are now without leaders. The war has taught us to utilize even the unskilled hands of women and children for common good by properly organizing them. Is the problem of organizing professional men any more difficult?

Research in Pure Science

One lesson which nation-wide strikes of organized labor and the profiteering on the part of certain groups of capitalists should have taught humanity is, that no vital function in national life can be safely left to groups of individuals. It hardly seems necessary at this time, right after the war, to explain or to prove that research is a highly important national function and consequently must be taken care of in the future by the nation as a whole. If our future is to be safeguarded against possible narrow tendencies or near-sighted policies or against immediate commercial demands, then research should not be left entirely in private or corporate hands.

Since the beginning of the war this fact has been realized in England perhaps more clearly than in any other country, both on account of military necessity and because of a well-founded anxiety regarding the expected keen commercial competition after the war. In England the government, the professional societies, various trade associations, colleges and universities—in fact, all the cultural forces of the country—became united in a vigorous organization and pursuit of research. Indications are that the impetus gained will carry them for many years to come and that their enthusiasm will not die too soon.

In this country neither military necessity nor commercial competition has furnished a stimulus of anything like equal strength, and it is becoming more evident that our good resolutions concerning research, made during war time, have been put away together with the songs of war and the steel helmets.

Training Research Men a University Function

It is true that large industrial interests are beginning to realize the importance of research more and more clearly and are doing some work in this respect, even if the results of it are not immediately available for general benefit. Nevertheless, the industrial laboratories are handicapped in two respects. One is the lack of trained scientists, the other is the dearth of any fundamental data and theories. This means that much time that should be spent in applied research has to be devoted to the training of the personnel and the derivation of basic data and theories. Herein lies the prime importance of colleges and universities. It is their direct function to produce trained investigators and to promote pure and general science upon which the industrial progress of the future will be largely based.

It has been pointed out on more than one occasion

that the sum total of scientific contribution by American colleges is surprisingly small, no matter what extenuating circumstances we take into account. There must be some quite cogent reasons for such a deficiency, and the sooner we discover and meet them the better it will be for our country and for the whole world. A perusal of reports of university presidents and an extended inquiry among professors themselves would probably elicit the well-known reasons, such as insufficient remuneration, lack of facilities, undue encumbrance with routine duties, etc.

These reasons should apply with much greater force in poorer countries, like Germany. Nevertheless, scientific contributions by professional teachers are particularly numerous and of high grade in that country, and this fact would indicate that the real reason for our backwardness in this direction must be sought elsewhere. Lack of support for higher studies and research is but an outward manifestation of the underlying attitude toward these things on the part of those who should know better. It has been rightfully claimed that this country spends immeasurably more per capita on the conveniences and luxuries of life than any other country in the world.

How long will it be before the present limitations in our universities will disappear and a new spirit will reign in them, the spirit of a renaissance? We had an inkling of this unselfish, idealistic spirit during the war. But do we really need a perpetual calamity to keep us in the right attitude toward science and research? Are we forced to acknowledge that, with a few exceptions, this country is destined to remain a business man's paradise and that research is to be carried on only for the sake of "what there is in it," colloquially speaking?

The ideals of the country need a thorough revision, and with this revision will come a new spirit in science and research. The only way to accomplish this change is by patient proselytizing and by example on the part of those who know the beauty of pure science and who see in it the only salvation of our industry in the next generation.

MATHEMATICAL RESEARCH HAS IMPORTANT FUNCTIONS

Any one perusing European magazines and proceedings of European societies in electrical engineering and physics cannot fail to be impressed with the far-reaching differences between their articles and American papers. Perhaps the most conspicuous distinction is a freer and a more skillful employment of mathematical means by the European writers. A more careful comparative study will further reveal that this freer use of mathematics goes hand in hand with a more pronounced European tendency toward generalization and rationalization, in contrast to our habit of publishing rather crude and disconnected data. In many cases these data are published even without literature references or mention of previous investigators.

Going back into the past of the science in Europe and in this country, one can readily see the profound historical reasons for this difference in scientific contribution. On the one hand, there has been the unbroken existence of a culture going far back into the Middle Ages, with well-established schools of thought and methods, traditions and standards; on the other hand, we have a new country, settled pre-eminently by men of the adventurous type who for nearly two centuries had problems to solve of a much more exciting character than those which they had left in their old homes. Even now, after a century of American science, our investigators are immeasurably more disjoined and separated than their European confrères. There are but a few definite schools of thought, geographically or figuratively speaking. In many cases the standard of scientific contributions in this country simply has to be sacrificed to quantity, in order to keep the professional societies and magazines active.

There is nothing either to conceal or to deplore in this situation. It is a result of our historial development, and we shall gradually approach European standards as time goes on. It is only necessary to see clearly our shortcomings and to cease thinking that we can disregard the progress of science in Europe. Mathematical research in physics and in electrical engineering must come to this country unless we are to be condemned to gross empiricism and to a maze of experimental data without a rational interpretation and without a possibility of prediction of new phenomena or numerical values.

Death of Dobrowolsky

Famous Engineer and Pioneer in Polyphase Machine and Transmission Work Passed Away in Heidelberg, Germany, in November

BY DR. CARL HERING

WORD has just reached this country of the death of Dr. Michael von Dolivo-Dobrowolsky on Nov. 15, 1919, at Heidelberg, Germany, in his fifty-eighth year. The pioneering and important work in electrical engineering accomplished by Dr. von Dolivo-Dobrowolsky was not so well known in this country as it should have been. He was one of the earliest to take up and develop polyphase transmission after Tesla had come out with his polyphase motor. He was at that time, about 1890, one of the leading engineers of the Allgemeine Elektricitäts-Gesellschaft of Berlin, and in co-operation with the noted C. E. L. Brown of the Oerlikon company in Switzerland he designed and constructed the world-famous Lauffen-Frankfort three-phase transmission plant, in which about 100 hp. was transmitted nearly 100 miles. This was the first practical long-distance alternating-current transmission plant in the world by which what was then a considerable amount of power was transmitted by commercial machines to what was then a great distance. At the time of this pioneering work in polyphase machines and transmission in the early nineties Dr. von Dolivo-Dobrowolsky wrote a number of articles for the ELECTRICAL WORLD. A number of his United States patents for polyphase systems, including that for the three-core three-phase transformer, were acquired by the General Electric Company.

A RUSSIAN BY BIRTH

He was a Russian by birth and nationality, his father's family belonging to the nobility of that country. His early life was spent in Odessa, in the south of Russia. He received his early education in that country, and was then especially interested in electrochemistry—what there was of it in those early days. In 1883 he went to Darmstadt, Germany, to take a post-graduate course in electrical engineering, which he decided to follow as a profession. The Polytechnicum there

was one of the first institutions in the world in those early days to give a special course in electricity. This course was in charge of Prof. E. Kittler. A year later young Dobrowolsky was made the assistant to his professor, succeeding his intimate personal friend, the writer, in that position. Years later, after his creditable career, this institution tendered him the honorary doctor's degree.

PIONEER WORK IN POLYPHASE CURRENTS

Dobrowolsky was one of the pioneers in reducing the Tesla polyphase system to practice and in developing the polyphase induction motor. He claimed to have been the first to show that to make such motors a success the distinctively polar-field windings described in the early Tesla patents must be changed into a distributed winding. This has since become the general practice, and it was this which made this type of machine such a success.

It is maintained also that he was the one who first coined the term "wattless" current (*wattloser Strom*), as well as the term "Drehstrom," which may be translated "rotary current," presumably because such currents produce a steady torque in a motor. Dobrowolsky early recognized that these currents constituted a steady, uniform flow of energy, like a direct current, and at the same time had the advantages possessed by alternating currents in being easily stepped up and down. He was keen to appreciate that this would solve the then very important problem of driving motors with alternating currents. His first motors were all of the squirrel-cage type, of which he was the first and acknowledged inventor, if the writer's memory be correct.

HIS PROFESSIONAL LIFE

Dobrowolsky's ideal in his earlier professional life was to become a teacher, and after he had shown his ability by his work a special position as professor of electrical engineering was created for him in his native country, at the University of St. Petersburg. He then gave up his prominent position in Berlin to take up this new work, and returned to his native country to settle there. He soon found, however, that the conditions in Russia were intolerable to him, and he decided to expatriate himself. Not wanting to become a German citizen or to have his two sons serve in the Germany army, perhaps to fight his native countrymen, he settled in Switzerland for some years and became a naturalized Swiss citizen, after which he returned to his former high position in Berlin in the largest electrical manufacturing company in Germany. Dobrowolsky resigned last March to retire and settle in Darmstadt, the beloved home of his student days. He died of arterial sclerosis in Heidelberg, after a long and lingering illness, soon after his retirement from active work. He often wanted to visit the United States, but dreaded the long ocean voyage.

Professionally Dobrowolsky was an ardent student, a clear thinker, a man of decided views, an able engineer, bold and fearless in his departures from the beaten track, an inventor of note, a broad-minded, well-posted scientist, and a linguist proficient in four if not more languages. Personally, he was a true, loyal and devoted friend and a charming companion to those who knew him intimately. He was married twice, the second time to a native of Holland, of noble birth, a widow with three young children to whom he was a devoted father. These children survive him, as do the two grown-up sons of his first marriage, whose mother was a native of Greece.

Chilean Census Shows Power Used Industrially

THE Chilean census for 1916, issued not long since, contains detailed information covering the industrial development of that country. The installation of prime movers used in manufacturing industries, which includes stations producing electric power for public service but apparently excludes mining, had in that year reached a total of 107,929 hp., of which 20.8 per cent was electrified. The production of gas and of electricity are not separately reported, but the combined industry shows an investment of $43,051,566, of which $7,571,429 is in buildings and $18,926,523 in machinery. The annual operating expenses were $6,080,336. Salaries and wages required expenditures of $2,197,334, and materials entailed a total outlay of $1,933,555.

The distribution of power-generating machinery by industries and by the different kinds of prime movers is indicated in the accompanying table. Each establishment contained on an average 7.5 machines with an average rating of 5.5 hp. Steam furnished 49.7 per cent of the motive power used in manufacturing, being followed by water wheels with 36.7 per cent. The gas and electric industry accounted for 63,489 hp., which was 58.8 per cent of the total installation.

MACHINERY AND MOTORS USED IN MANUFACTURING INDUSTRIES OF CHILE IN 1916

Industry	No. of Estab.	No. of Machines	Steam		Gas		Suction		Electrical		Hydraulic		Petroleum	
			No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
Alcohol and beverages	173	748	98	5,346	11	274	3	116	197	3,536	11	1,579	10	482
Pottery and ceramics	5	100	6	64	4	62	...	.....	11	99	1	15	...	.....
Food preparations	738	2,757	194	6,998	72	703	18	598	356	4,403	97	5,080	68	1,324
Gas and electricity	92	73	98	27,323	4	465	25	1,777	58	5,813	56	29,603	35	4,321
Shipbuilding	17	35	8	577	...	.....	...	.....	8	40	...	.....	...	.....
Clothing industries	312	1,988	7	161	4	97	2	80	82	321	1	25	...	.....
Lumber industries	201	1,313	154	4,420	11	192	...	.....	80	990	...	.....	12	57
Building materials	55	110	8	1,924	...	.....	3	170	21	381	8	450	2	240
Textile industries	27	1,773	13	1,299	2	38	5	420	49	709	27	927	2	68
Metals	207	2,315	29	592	39	388	15	603	138	1,018	6	100	15	245
Furniture	62	241	12	127	3	36	1	4	22	15	1	5	...	.....
Paper and printing	154	2,038	7	192	23	312	...	.....	435	1,728	10	1,310	7	34
Leather and furs	315	4,420	47	1,251	21	579	3	194	159	1,871	11	166	3	55
Chemical products	112	953	63	2,034	10	176	5	187	60	749	12	369	6	72
Tobacco manufacturers	54	374	4	139	6	70	2	34	30	388	...	.....	5	23
Vehicles	36	154	4	65	6	63	1	22	28	144	...	.....	3	19
Other industries	65	274	23	1,163	...	.....	...	.....	32	202	2	10	3	13
Total, 1916	2,625	19,666	775	53,675	216	3,457	83	4,205	1,766	22,547	243	39,639	171	6,953

Readers' Views and Comments

Proper Interpretation of Boiler Ratings

To the Editor of the ELECTRICAL WORLD:

SIR: I shall be pleased to have you publish a correction to my article on "Design of a Unit Boiler Plant" in the issue of Feb. 7. In the table showing kilowatt capacity from a given number of units it is stated that the light-face figures represent 275 per cent boiler rating, the boldface figures 350 per cent boiler rating. These figures as used are deceptive. The idea which I intended to convey was that the unit, including the economizer, would deliver a total output which measured by boiler-horsepower would equal 275 per cent and 350 per cent respectively of the rating of the boiler itself. A similar reference is made to these figures in the first paragraph at the top of page 317. LOUIS R. LEE.

Columbus, Ohio.

Wages, Hours and Production

To the Editor of the ELECTRICAL WORLD:

SIR: There was a time when the efficiency of American labor was such that it was profitable for contractors to pay the passage of—for instance—bricklayers to Europe and back and pay them while there the American scale of wages rather than employ the slower labor of the Old World. This was before there had been imported into America from that same Old World the doctrines of restricted production and dead-leveling that are now working havoc in many a trade. It is not a question of wages. Every reasonable employer will admit the justice of most of the very substantial increases in pay that have been made as a result of conditions following the war. The dollar buys only half as much of most commodities as it once did, and—without inquiring too closely into cause and effect—it is obvious that, unless the national standard of living is to be lowered, wages must be raised in the inverse proportion just as fast as it becomes possible to do so. The wage earner has borne his share of the war's financial cost. His immense losses in the value of savings and insurance can never be made good, but the relation between his pay and what he can get for it must eventually reach its old equilibrium at least. In many trades it has already done so. In some there has been an actual betterment.

When, however, labor, as represented by the trades unions, coupled with its demand for large increases in wages a further demand for shorter working hours it defied all logic and all reason. In the order of nature the two things do not go together. An unselfish public spirit might well have included with the demand for increased pay an offer—in the trades, that is, where the hours were already short, say eight or less—temporarily to extend the working day, without asking overtime, until something approximating the old rate of production should be attained. That would have been inspiring and would have placed the unions making the offer on a plane of practical patriotism entirely above criticism.

Doubtless it would have been too much to expect of human nature; but that an aggressive opposite course—whether inspired by laziness or by the wish to increase the wages asked still more by making overtime obligatory if the work was to be done—was the one chosen, showed that labor leaders as well as generals and statesmen can make blunders that resemble crimes. When men worked ten or twelve hours a day for six days a week at their trades, as they did within the memories of those far from old, how enticing and self-evident the old formula of "Eight hours for work, eight hours for sleep, eight hours for rest and recreation" seemed! Now eight hours is held by radical agitators to be little better than slavery. Similarly, in the view of such men, output must be limited by the standard of the incompetent or the slothful. Piece work—once the joy of the fit and the ambitious—is prohibited, or the speedy are held down to the level of the mediocre. In the meantime the world clamors for commodities and prices continue to mount. FRANK W. CHASE.

Brooklyn, N. Y.

The Pennsylvania Railroad's Electric Locomotives

To the Editor of the ELECTRICAL WORLD:

SIR: On page 127 of the ELECTRICAL WORLD for Jan. 17, I note an error in the description of the Pennsylvania Railroad's latest electric locomotive. The description says that it is a direct-current, side-rod-drive engine and used between New York and Manhattan Transfer, N. J.; also that the railroad operates an alternating-current locomotive which is the most powerful electric locomotive built thus far.

On the contrary, the picture shows the Pennsylvania's 259-ton, alternating-current, geared-side-rod freight locomotive, which was built at the Juanita shops of the railroad and has been in experimental service on the Philadelphia-Paoli electric division since 1917. It has never been this side of Philadelphia except while on exhibit at the American Electric Railway Association convention at Atlantic City last summer.

A few details follow:

1. It is operated on a 11,000-volt, single-phase, 25-cycle trolley through one or both double-shoe pantographs.

2. It is driven by four three-phase, wound-rotor-type induction motors, two pairs of which drive two jack shafts that in turn are connected to the 72-in. driving wheels through side rods.

3. It cannot operate on direct current.

4. A rotating phase converter changes the single-phase trolley current to three-phase for use in the motors.

5. Maximum speed is 20.6 miles per hour.

6. Speed variations are produced by use of a water rheostat in the rotor circuit of the main motors.

7. The engine has developed 140,000 lb. tractive effort in starting, being designed for heavy service on the mountain division not yet electrified.

8. The Pennsylvania Railroad has no other alternating-current electric locomotive of higher speed except the Norfolk & Western freighters, which make a maximum speed of 28 miles per hour.

9. The New Haven road has the fastest alternating-current electric locomotives in this country.

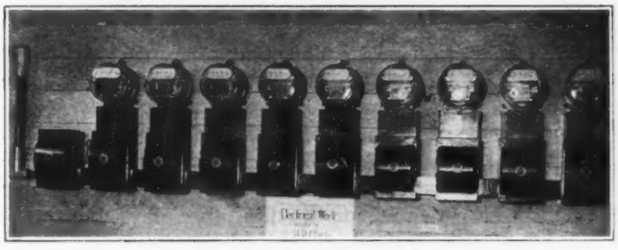
New York City. M. F. CLEMENT.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Compact Meter Installation

BY ARRANGING the meters in a Worcester (Mass.) apartment house as shown the electric service company has made it possible to read the meters quickly and accurately. The service is brought into the basement by conduit and is carried through a main switch and fuse box and thence horizontally along the baseboard in the form of a protected three-wire bus from which the local branch circuits are tapped. The main



ALL CIRCUITS, FUSES, SWITCHES AND TERMINALS ARE INCLOSED

fuses are rated at 30 amp. and the branch fuses at 6 amp., nine apartments being served. The branch circuits are fed through 5-amp. meters and are alternated on either side of the three-wire bus. Johns-Pratt service boxes are used, and not a single exposed wire appears in the installation. That there is a considerable diversity factor in the loads appears from the fact that the combined branch circuit fuses total 54 amp. against the 30-amp. main fusing.

Interpole Strength Adjusted on the Job

TO OBTAIN sparkless commutation, which is the greatest advantage of using interpoles, care must be taken to have the correct strength of pole. This may be checked with exploring points or brushes placed $\frac{5}{16}$ in. (5 mm.) apart on the commutator when the machine is operating at full load. Under these conditions the voltage under the toe (leaving edge) of the brush should be 0.1 volt to 0.2 volt for 115-volt machines and 0.2 volt to 0.4 volt for 230-volt or 500-volt machines. The forward point should be even with the toe of the brush. If steady full-load cannot be obtained, any load over half full-load may be used, in which case the values given above should be multiplied by the proportion of full load carried.

It is not necessary to take observations of the whole curve from pole to pole. Readings from about 1 in. (2.5 cm.) ahead of the brush to about 1 in. behind it at intervals of $\frac{1}{4}$ in. (6 mm.) apart give the needed information, when plotted in the form of a curve. Sometimes when interpoles are not all of the same strength it is necessary to plot a curve for each brush and adjust the interpoles individually to make each one right.

Interpole strength can be adjusted as follows: If the interpoles are too weak, the shunt should be removed, but if doing this makes the strength too great, a higher resistance shunt can be used. If the shunt has already been removed, the interpoles must be shimmed to reduce the air gap. Bolted interpoles can be shimmed by loosening the bolts and placing a shim between the frame and the pole. Cast-in poles must have a shim placed between the pole and the shoe. To do this, however, the armature must be removed. If one interpole is considerably weaker than the rest, it is an indication that there are short-circuited turns in its winding. If the winding is in good condition, however, it may be necessary to add an extra turn or an extra shim. On the other hand, if interpoles are too strong, a shunt must be added or shims removed.

Sometimes the interpoles will be too strong and at the same time will give an irregular voltage curve. In such a case it will be better to weaken them by increasing the air gap instead of putting on additional shunts. Whenever it can be done the interpole strength should be adjusted so as to be correct without the shunt; then accidental changes are not so likely to occur in the future.

JAMES DIXON.

Ampere, N. J.

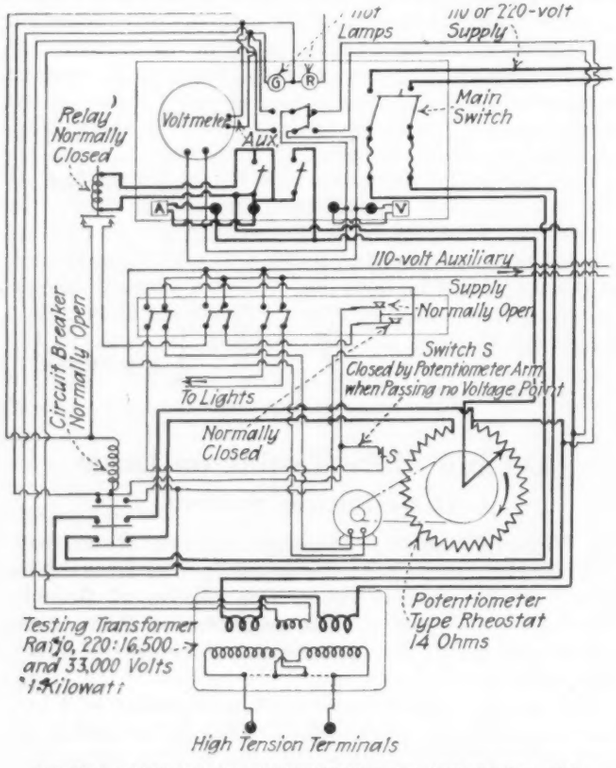
Oil and Glove Testing on Large Distribution System

A TESTING outfit for testing insulating oil and rubber gloves has been developed for the laboratories of the Hydro-Electric Power Commission of Ontario. The wiring diagram of this apparatus is shown here, and an account of the connections and method of operation follows.

The testing transformer used has a capacity of 1 kva. Its secondary may be connected in parallel or series and it is provided with series resistances of high value. The primary voltage is controlled by means of a circular potentiometer-type rheostat connected to the 220-volt mains. The secondary voltage is calculated from measurements across an exploring coil or on the primary winding. In the main supply circuit an electrically operated oil-immersed contactor which is normally open is inserted. This contactor is closed by applying 110-volt, 25-cycle energy to its operating coil and is opened by gravity. The rheostat arm is free to rotate continuously and is arranged to be driven by a motor through a reducing gear. When passing the no-voltage point the rheostat arm momentarily closes a small auxiliary switch in the control circuit, thus causing the main contactor to close and incidentally to short-circuit the auxiliary switch. The contactor remains closed as long as the control circuit is complete. Connected in the main power circuit is a small instantaneous overload series relay which on a heavy rush of current such as that caused by a flashover on the secondary load of the transformer opens the control circuit and allows the contactor

to fall out. Push-buttons are provided for operating the contactor independently of automatic control. Pilot lamps indicate whether the contactor is open or closed.

The method followed in testing oil is as follows: The sample is placed in a cup within which is a spark gap formed by two 1-in. (25-mm.) disks, 0.1 in. (2.5 mm.) apart. The main knife switch is then closed. The voltage, being varied by the motor-driven rheostat, may at this moment have a value greater than the oil can withstand. If breakdown of the oil occurs, the resulting primary current rush acting through the small relay, opens the power circuit. The rheostat arm, driven at a constant speed, continues rotating, though electrically dead, until it reaches the no-voltage point, where it closes the auxiliary switch, thus operating the contactor and energizing the transformer. As the rheostat arm rotates the voltage steadily increases until breakdown



WIRING DIAGRAM OF CONNECTIONS OF APPARATUS FOR TESTING OIL AND RUBBER GLOVES

through the oil occurs, when, as before, the relays at once clear the transformer from the line. The advantage of shortening the flash period is that it lessens the formation of free carbon in the oil and saves unnecessary heating of the rheostat and transformer. It also prevents burning of rheostat contact points.

Meanwhile the voltmeter pointer has been rising, and at the moment that the power circuit is opened it is locked in the position of maximum deflection; thus ample time is given the operator to obtain a reading before the machine begins its next cycle.

On transformer oils that are not defective breakdowns are taken on each pint of the sample of oil. Two hundred or more samples can be tested in an eight-hour day.

In rubber-glove testing the rheostat is operated manually and the contactor is controlled by the two push-buttons. The auxiliary switch on the rheostat, not being necessary in this test, is cut clear by the switch which controls the motor. The gloves to be tested are filled with water and suspended with fingers down in a jar of water, being immersed to about 1 in. from their tops, thus insuring even potential stress over the entire surface. Voltage is applied between the inside and outside of the glove. A potential difference of 10,000 volts is generally used, this voltage being raised slowly and held for several minutes, the length of time depending on the test requirements.

For capacity tests on small condensers provision is made for connecting instruments into the primary circuit. Flat insulation may either be placed in various types of gaps or between points in the holder, or it may be tested in the cup under oil.

Toronto, Canada. DOUGLAS BORDEN.

Drying Generator Insulation After Shipment

THE insulation of a direct-current machine may absorb enough moisture between the time when it is shipped and the time it is ready to start to reduce the insulation resistance considerably. If this resistance is too low, enough current may flow through it to start charring and breakdown of the insulation. By the A. I. E. E. formula for the minimum allowable value a 200-kw., 250-volt machine should not have less than 210,000 ohms resistance. A safe and conservative practice is to dry out any machine showing less than 500,000 ohms when new.

The ordinary method of testing for insulation value is to operate the machine at about one-fourth of rated voltage and measure the voltage between each terminal and ground. If the voltmeter readings are not over two or three volts, the machine may then be brought slowly up to speed and voltage. When the machine is running at full voltage an insulation resistance of 500,000 ohms, if uniformly distributed, will give a voltmeter reading of 7 volts between each terminal and ground.

The voltmeter should be a high-grade meter with a resistance of about 100 ohms per volt, or 30,000 ohms for a 300-volt scale. If a switchboard meter is used, its resistance must be known to judge whether the deflection to ground is too great or not. The higher the resistance of the meter the greater will be its deflection for a given amount of leakage, and therefore the use of a high resistance meter is recommended.

Other methods, such as measurement of insulation resistance by megger or Wheatstone bridge are reliable and satisfactory, but apparatus for these tests is usually not available on the road.

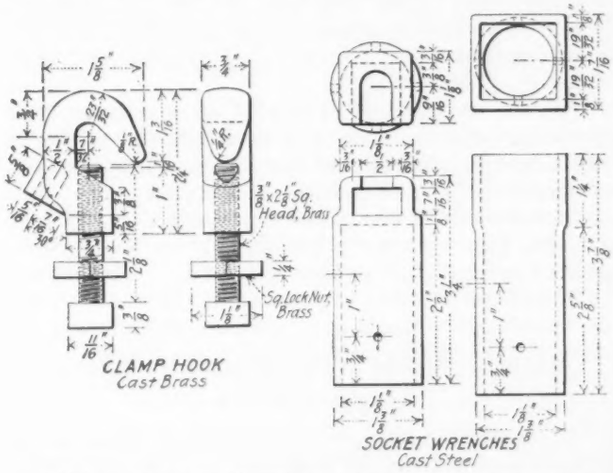
How to Test the Emergency Trip of a Steam Turbine

Weekly tests of steam-turbine governors and emergency trips should be made in all plants to guarantee their proper operation when needed. The emergency trip can usually be tested either by directly releasing the latch or, better still, by operating the governor with a small lever and overspeeding the turbine until the latch trips automatically. Of course, for this test the turbine must not be on load in parallel with another machine. THOMAS HALL.

Ridgway, Pa.

Safe Method of Tapping Live High-Tension Lines

TRANSFORMERS and branch lines can be tapped on to live transmission lines at any point without in any way endangering the linemen when a special connecting device designed by the engineers of a Middle West utility is used. The connector consists of a cast-brass hook with a square-head brass cap screw and a



HOOK CLAMP AND SOCKET WRENCHES FOR CONNECTING TO LIVE LINES

locknut. A special pair of wrenches mounted on opposite ends of a 6-ft. (2-m.) insulated stick are used to install or remove the clamp.

Before installation the tap wire is cut to the proper length and is soldered into a hole drilled in the back of the connecting hook. The special wrench on one end of the stick is slipped over the bolt head and the device is hooked over the line wire. Then the wrench handle is twisted until the wire is tightly clamped to the line. By reversing the wrench handle the locknut can be screwed up with the socket wrench at the opposite end of the stick. If it ever becomes necessary to remove such a tap connection, the procedure is reversed. The device has been in successful use for more than three years on bare lines operating at potentials up to 27,000 volts. A longer wrench handle should be used on higher voltages.

R. L. DODD.

Milwaukee, Wis.

Distribution Auditor Saves Transformer Purchases

SOME of the properties operated by Henry L. Doherty & Company have recently been visited by the company's distribution auditor with a resultant saving in transformers. In one city of the Middle West it was possible to suggest changes in the distribution system which saved so many transformers that the company will not need to buy any for more than a year.

The distribution auditor on visiting a station gets together the superintendent of lines, a foreman, a lineman, an automobile driver and his own engineer and studies the conditions. First, they follow a primary circuit from where it leaves the plant to its end and record data regarding every pole and cross-arm. After the primary lines have been studied they follow the secondary in the same way. Then they go back toward the plant on the same circuit, following every service and meter loop, taking readings on the meters and counting the customers' connected load. Later they make load tests on the feeder and load tests on each transformer. After the entire system has been thus inventoried the distribution auditor makes recommendations for such revisions of the system as may seem to be economical.

In distribution systems that are typical of average-sized cities it is said to be surprising how simple changes can sometimes be made to effect considerable savings. This is due to the fact that distribution systems have usually grown up in a piecemeal fashion and the necessary amount of time has not been given to co-ordinating the various parts.

Lamp Filaments Near High-Voltage Conductors Broken by Vibration

IN A NUMBER of the modern substations of the Southern California Edison Company, such as that shown in the half-tone, annoyance was caused by the breaking of filaments in incandescent lamps which were installed near the high-voltage conductors. The trouble was caused by the alternating magnetic field maintaining continuous vibration of the filament. Since it was

MAGNETIC FIELD NEAR CABLES BROKE LAMP FILAMENTS

advisable to have the lamps placed in the positions shown by the arrows in order properly to illuminate the disconnecting switches, it was necessary to replace type B "Mazda" lamps formerly used by type C lamps, which had more rugged filaments. As the brilliancy of these lamps is higher than that of those formerly used it was necessary to use bowl-frosted globes. Since the change was made the loss by breakage has been reduced to almost nothing.

A. E. GEORGE.

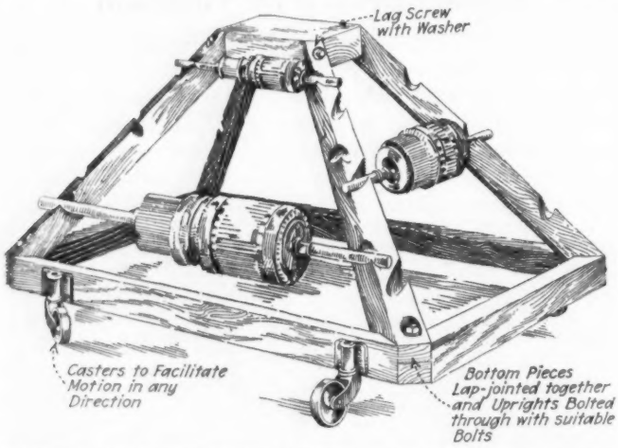
Los Angeles, Cal.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Large-Capacity Portable Stand for Holding Armatures

BOTH large and small armatures can be accommodated by the portable armature stand shown, which is in use in a large motor-repair shop in New York. This stand is made of timbers fastened securely together and slotted to receive the armature shafts. Strong casters at each corner of the base, make it an easy matter


Lag Screw with Washer
Casters to Facilitate Motion in any Direction
Bottom Pieces Lap-jointed together and Uprights Bolted through with suitable Bolts

WOODEN ARMATURE STAND WHICH CAN BE MOVED AROUND THE SHOP

to move the stand anywhere in the shop. Besides being used for holding armatures of motors whose stators are being repaired, the stand is handy for supporting armatures to which air-drying varnish has been applied.

New York, N. Y. W. A. HARRIS.

Armored Cable 4,000 Ft. Long Lowered Into Shaft

IN PLACING heavy armored cables in its shafts the Quincy Mining Company, Hancock, Mich., uses a steam locomotive to do the lowering. The reel is set up on a flat car near the shaft house, and a length of several hundred feet is fed down the shaft by turning the reel. An arrangement of heavy timbers at the door of the shaft house is then used to clamp the cable, and the engine is moved back away from the shaft house, unreeling the cable. The reel is then locked, the timber clamp released and the car and reel pushed toward the shaft house, feeding the cable down the shaft by its own weight. When the reel reaches the shaft house the cable is once more clamped with the timbers, and the engine moves back, unreeling several hundred feet more. This operation is repeated until the cable is fed down. The cable is then securely clamped to the mine timbers and the work is completed.

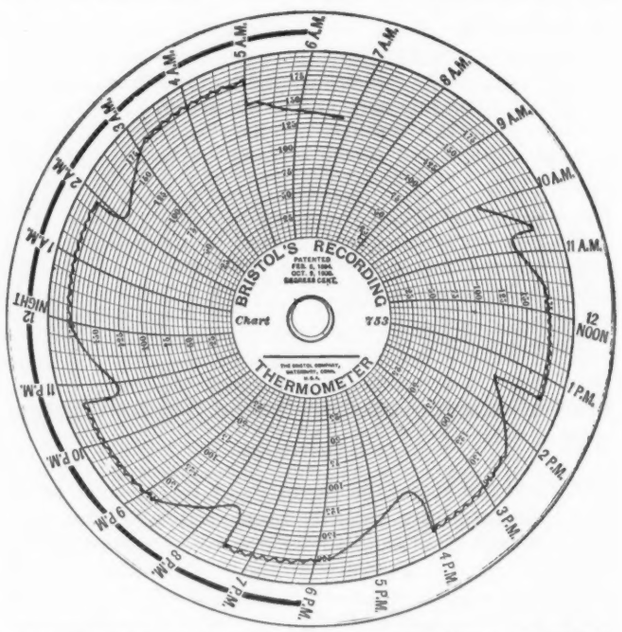
A piece of cable 4,000 ft. (1,220 m.) in length is the heaviest that has been handled in this district. The cable is made up of four No. 1 rubber-covered wires, insulated over all with rubber for a working pressure of 2,300 volts. Over this are coverings of jute and galvanized-steel wire armor. The weight of the cable is 4 lb. per foot (5.8 kg. per m.) or a total weight of 16,000 lb. (7,250 kg.).

With the exception of tearing off some of the outside covering, the installation was made without injury to the cable, but it is believed that this is about the limit of weight that can be handled in one piece. The shaft in which this cable was placed is inclined about 58 deg., and this partly accounts for the ability to handle a piece of cable of this weight. J. C. KENDALL.

Chief Electrician.

Electric Coils Help Regulate Oven Temperatures

EXTREMELY close regulation of oven temperatures by the installation of both steam coils and electric grids has been obtained in a Massachusetts factory, the steam coil providing the main body of heat and the electric coil supplying the regulation required. The oven is 9 ft. x 7 ft. x 6.5 ft. (2.7 m. x 2.1 m. x 2 m.) in dimension and contains twenty legs of 2½-in. (6-cm.) coils supplied with high-pressure steam from the shop mains. There are also eight grids of 20 kw. combined rating,



TEMPERATURE CHART SHOWS CLOSE REGULATION OF OVENS

governed by an installation of Tycos temperature control, with Westinghouse solenoid switches and push-button equipment for starting and stopping.

The accompanying record from a Bristol chart shows the temperature variations from 10 a.m. to 7 a.m., six heating cycles being made during this period. In a

typical run the oven doors were opened at 1:20 p.m. to receive the charge, the temperature dropping from 180 deg. C. to 125 deg. C. (350 deg. F. to 250 deg. F.) in about four minutes. The charge was then inserted, and at 2:25 p.m. the operating temperature of 175 deg. C. was reached and maintained by the thermostatic control of electrical energy input until 4 p.m., when the work was withdrawn from the oven. During the period of steady heating the temperature fluctuated only about 5 deg. C., or approximately 2.8 per cent of the full-load temperature.

Chorded Armature Windings Reduce Reversal Emf.

BY THE use of fractional pitch or chorded armature windings on direct-current machines, commutation of this type of machines has been greatly improved, declares the Westinghouse Electric & Manufacturing Company. When full-pitch windings were used the two sides of each commutated coil were in the same slots as the other coils, being commutated at the same instant. Thus the normal emf. generated, due to commutation or reversal, was that due to upper and lower coils in each slot. By the use of coils having a throw of one or more slots less or greater than the pitch, the commutated coils could be made to lie in separate slots so that the emf. of reversal was thus very materially reduced.

Portable Equipment for Charging Batteries

ABSOLUTE automatic operation is the feature of the storage-battery charging equipment which has been built for use on several piers at San Francisco, Cal. Two outfits are in use, one being capable of both charging and discharging batteries and the other being used for charging only. The equipment consists of a two-bearing motor-generator set, a switch and meter board and a starting switch, all mounted on a rubber-tired truck. Each outfit will charge a battery of forty-two Edison type A 6 cells at a constant charging rate throughout the entire charge without the attention of the operator. The battery is placed on charge at night

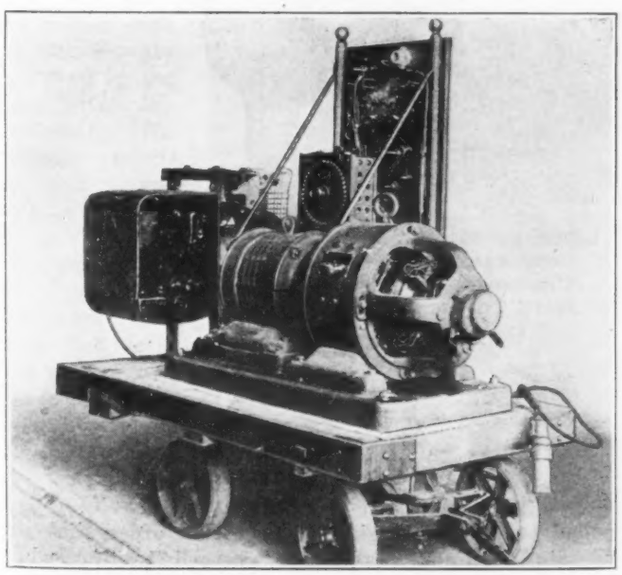


FIG. 1—REAR VIEW OF OUTFIT WHICH WILL BOTH CHARGE AND DISCHARGE STORAGE BATTERIES

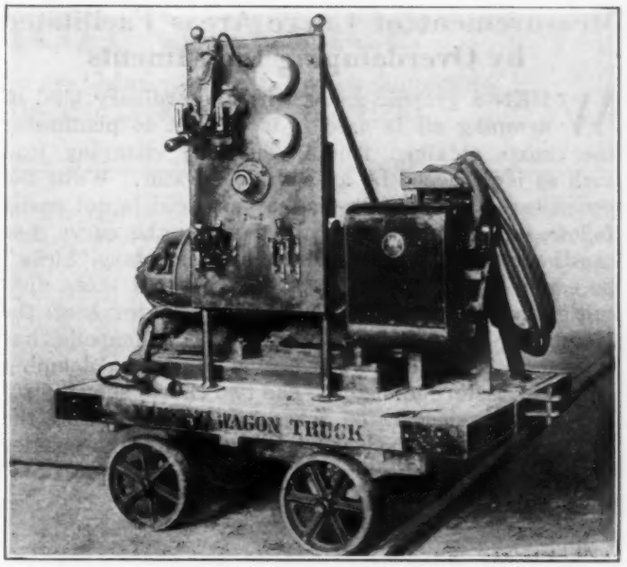


FIG. 2—FRONT VIEW OF OUTFIT USED FOR CHARGING ONLY

and in the morning the storage batteries are fully charged ready for operation. This is accomplished by automatically disconnecting the battery from the line when the battery is fully charged. If power to the motor should fail, the battery is automatically disconnected from the generator, so the battery will not run reversed. Upon the return of the energy to the motor, however, the motor-generator set is automatically started and the battery automatically reconnected. This feature is especially valuable because it eliminates constant attendance. The motor is protected against overload and single-phasing by means of an oil circuit breaker. The generator is also protected against overload by means of a single-pole carbon circuit breaker.

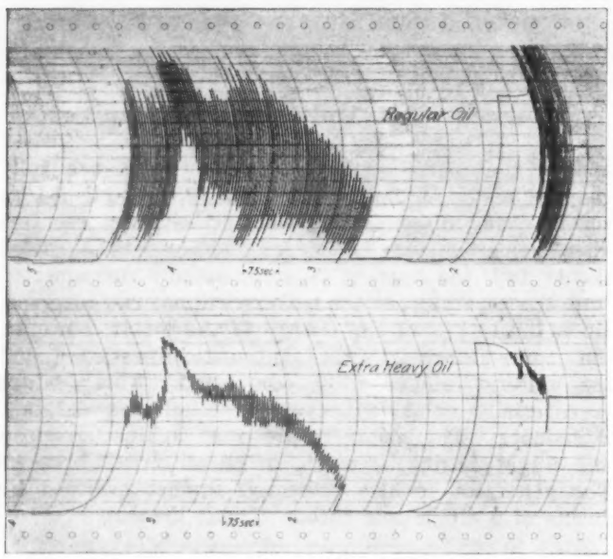
Loose Motor Shaft Causes Insulation to Chafe

CHAFING of insulation at the ends of the armature slots of a 15-hp. direct-current motor driving a drug mill, which resulted several times in a grounded winding, was found after a long investigation to be caused by a loose motor shaft. Before the cause of the chafing was determined the motor repeatedly gave trouble. The insulation was found cut in different slots, and although the motor was temporarily repaired by replacing the insulation, it finally had to be rewound. In rewinding, the coils were protected with extra layers of insulation, but the trouble did not disappear, so the armature was taken from the frame for examination. After removing the coils the armature was placed in a lathe and its core was made stationary by means of a tool held in the tool post. Then it was noticed that on pulling the lathe belt the motor shaft revolved slightly in the core. When the core was taken off the shaft the keyways in the core spider and the shaft were found to be of different widths, allowing some rotation of the core on the shaft. As the load on the motor was one which increased and decreased suddenly, the coil leads connected to the commutator were worked back and forth in the slots as the load changed, and this chafed the insulation. By cutting a new keyway and using a larger key the trouble was entirely removed.

Utica, N. Y. L. A. FRANCIS.

Measurement of Curve Areas Facilitated by Overdamping Instruments

WHEN a graphic meter with the ordinary kind of damping oil is used it is difficult to planimeter the charts obtained from a suddenly changing load such as is produced by an electric elevator. While the pen does not overswing, the curve traced is not easily followed in measuring the area under the curve, nor can the general curve, exclusive of momentary "kicks," be easily visualized by the eye. To avoid these difficulties in making tests on suddenly changing loads the Merchants' Heat & Light Company, Indianapolis, has experimented with a very heavy oil in the damping box of an Esterline meter. The two charts shown were taken simultaneously on the same load, one with the ordinary oil furnished and the other with the heavier



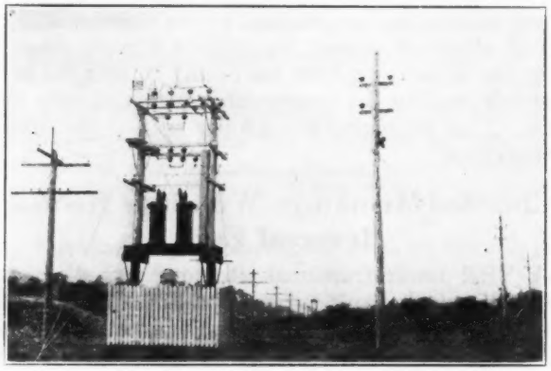
CHARTS FROM ORDINARY AND OVERDAMPED METERS

oil. With the heavy oil it takes about eight seconds for the needle to drop from full load to zero or to rise from zero to full load. Careful planimetering of both curves showed that the areas for any reasonable length of time were equal.

Outdoor Substation for Railroad Interlock System

BECAUSE continuity of operation is so essential in railroad signal equipment duplicate transformers have been installed for the electric interlocking system protecting the crossings of the Pennsylvania Railroad with the Buffalo, Rochester & Pittsburgh Railroad and the Erie Railroad at Riverside Junction, N. Y. The transformers, which are rated at 5 kva., single-phase, 22,000/3,300 volts, 60 cycles, are mounted, together with their switching equipment, on two wooden poles, as shown in the illustration. By means of two double-throw, single-pole disconnecting switches either transformer may be connected to the 22,000-volt source of supply. The high-tension equipment consists of long-turn choke coils, high-speed sphere-gap lightning arresters, carbon-tetrachloride fuses and air-break switches of the double break-per-phase type.

The 3,300-volt leads are connected by switches to a power distribution line over 2 miles (3 km.) long, supplying energy to the interlocking plant. This is transformed to 110 volts for operating distant signals and again transformed to from 8 volts to 12 volts for energizing track circuits. Transformers operating at



TRANSFORMERS FOR RAILROAD SIGNAL SYSTEM

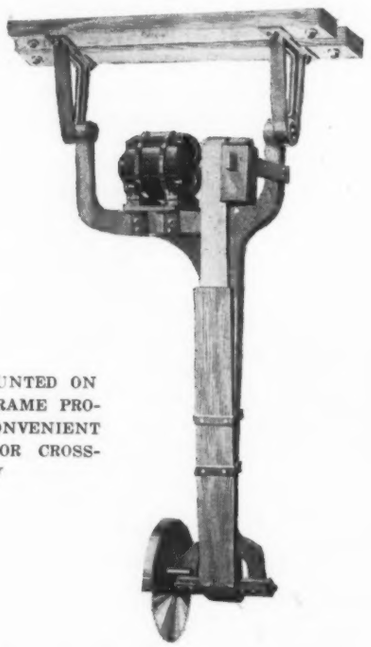
3,300/220 volts supply energy to a motor-generator set to charge a battery in the signal cabin. This battery supplies 110-volt direct current for operating and lighting the home and dwarf signals and for operating the switches and derails near the cabin.

Moloney transformers and Delta-Star high-tension equipment are used. E. W. KOLB.

Pittsburgh, Pa.

Individual Motor Drive for Swinging Frame Cross Cut Saw

FOR driving an American swinging-frame cross-cut saw, an industrial plant in Connecticut has adopted the method illustrated of mounting the motor directly on to the cross-frame of the saw. The motor is served from a wall outlet just back of it, the conductors being



MOTOR MOUNTED ON CROSS FRAME PROVIDES CONVENIENT DRIVE FOR CROSS-CUT SAW

coiled to allow swinging of saw. In order that the operator shall not be injured by the belt it is incased as shown. The motor is controlled by means of a 30-amp. C.R. General Electric push-and-pull switch mounted near the operator.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Sales of All Appliances Except Irons Increase

APPLIANCE sales made by the Public Service Company of Northern Illinois, Chicago, Jan. 1 to Dec. 1, 1919, reached an amount of money more than 75 per cent greater than the sales made in the corresponding period of 1918. This percentage will probably be increased when the figures for the month of December are considered. Fewer irons were sold in 1919 than in 1918, but with this exception every line of appliances gained over the previous year. Expressed in percentages of sales for the eleven months, washing machines gained 55 per cent, vacuum cleaners 155 per cent, fans 70 per cent, grills 200 per cent, portable lamps 350 per cent and vibrators 100 per cent.

Postal Pillars That Represent a Steady Load of 142 Watts Each

MORE than 200 postal service pillars such as are shown in the accompanying illustration are installed in the city of Toronto, Ontario, and electrically operated as a twenty-four-hour load with a demand of 142 watts from the circuits of the Hydro-Electric system. These pillars are operated by a company under a license from the government to install them wherever there is a postal delivery and in such quantities as are approved by the Post Office Department. The company erects the pillars and installs the stamp-vending machines, while the Post Office Department loads the machines and collects the money. The upper part of the drum shown in the illustration is used for advertising. The mechanism which moves this drum is operated by a solenoid which works a plunger acting against a spring. This solenoid is energized by a "flasher." The action of the mechanism is such that the drum is revolved through 90 deg. every three minutes. The advertisements are lighted by an electric light mounted inside the drum. The stamp-vending machines contain 1,000 one-cent and 1,000 two-cent stamps with an electric heating element to keep the stamps in a condition to be used.

STAMP VENDING AND ADVERTISING PILLAR INSTALLED ON STREETS OF TORONTO

Allowances to Customers Reduced 60 per Cent

ALLOWANCES to customers on bills rendered by the Springfield (Mo.) Gas & Electric Company were about $2,500 less in 1919 than in 1918. In terms of the gross revenue this means a reduction from 0.73 per cent to 0.31 per cent. C. N. Garrison, assistant secretary-treasurer of the company, attributes the marked reduction in allowances to greater promptness in adjusting complaints and to increased accuracy on the part of meter readers.

The policy of the company is to settle complaints concerning bills immediately if at all possible. It has been found that many customers who will settle for 50 cents when they make a complaint will not be satisfied with three or four times that amount a few weeks or days later. It is not only cheaper but it is considered good public policy to settle with a customer on the spot, even if the customer appears to be getting a little the better of the deal.

The source of most justified complaints is inaccurate readings. Hence meter readers are encouraged to do good work by a system of bonuses, $10 being given to every man who goes through a month without making a mistake. Those who make some errors are graded each month, and the first, second and third, in point of correctness, get $5, $3 and $2 respectively.

Disadvantages of Flat Rates for Irrigation Installations

THE present schedule of charges for irrigation pumping installations on the system of the San Joaquin (Cal.) Light & Power Corporation provides for a flat-rate system based on the number of months a year the motor is in use. The irrigation load is largely seasonal, and it was felt that, knowing the purpose for which the motor was designed, it was possible to determine in advance just when the period of use would be.

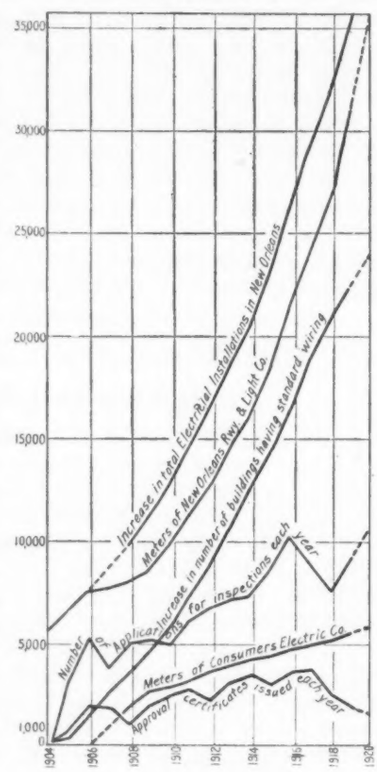
This type of rate in practice has, however, developed many difficulties. The progressive farmer needs power throughout the year. In the California valleys it is becoming more and more the custom to irrigate in winter in the preparation of the ground for the next summer's crops. With the continuing drain upon the soil it is found profitable to raise fertilizer during the winter and turn the crop under. Moreover, the farmer has other uses for his motor than to supply irrigation needs, and if he is free to use it, will install wood saws, silage cutters and other equipment. From the standpoint of

the company which supplies the energy, on the other hand, the disconnecting of transformers itself has meant considerable inconvenience and expense. Some farmers have used power for three months in the year, with intervals between, necessitating that the installation be connected and disconnected each time. This has been done by disconnecting the primary transformer fuses and sealing the plant, and one man was kept continually busy tending to such requests.

These considerations, combined with the benefits which would be derived from distributing the load so far as possible, rather than to concentrate it within a few months, as is the tendency with the present rates, have led the San Joaquin Light & Power Corporation to apply for a new schedule of rates, which is now before the California Railroad Commission. The new rate calls for a yearly charge, to be paid monthly, based on the installed capacity, together with a monthly charge for the amount of energy actually consumed. This amounts to $15 per horsepower-year plus 1 cent per kilowatt-hour consumed in each month. It is felt that this type of rate will encourage the farmer to scatter the load and will work to his benefit and convenience as well as to that of the power company.

New Orleans Company Shows 70 per Cent Increase in Customers

ON DEC. 31, 1919, the New Orleans (La.) Railway & Light Company, now under the management of John S. Bleecker for J. D. O'Keefe, receiver, had 31,799 meters connected to its lines. This was a growth of 3,807 for the year 1919, as compared with a growth of 2,284 for the year 1918. Of the 1919 installations about 250 were for power customers, while of the 1918 installations 215 were for power customers.



GROWTH OF ELECTRICAL BUSINESS IN NEW ORLEANS FOR PAST FIFTEEN YEARS

During the year a building boom was under way in New Orleans as indicated by the accompanying curves, made up by the electrical department of the Louisiana Fire Prevention Bureau, showing increases in the use of electricity and the regulation of wiring by electrical inspection. The curves show a decidedly upward tendency in all electrical work. The number of applications for inspection each year shows an upward tendency for 1919, while the approval certificates issued show a downward tendency for the year 1919. This is explained by the fact that the permits issued during 1919 were in the main for extensions on existing approved installations, on which approved certificates are not required. On the whole, these illustrations show a very healthy increase in the electrical business of the city.

Explaining the Differential

R. S. Hale Shows How His Company Bases Its Varying Rates on the Avoidance of Charges the Traffic Will Not Bear

SPEAKING before the Boston Edison Company section of the National Electric Light Association, R. S. Hale, in reply to an inquiry concerning the company's rates for electric heating, took occasion to emphasize the fact that the Boston Edison's rates are "made on the exact opposite to the theory which is so objectionable, of charging all the traffic will bear"—that is, the company "does not charge what the traffic will not bear." The plan of differential charges worked out with this principle in view was explained by Mr. Hale, who went back to the days when electricity was first sold for motor service.

"When people tried to use our product for power," said Mr. Hale, "they found that, though the quality was good, the price was so high they could not afford it; in other words, our price for power was more than the traffic would bear. I suppose we figured on cutting the price of lighting so that people could use the service for either, but we found that to make the price for all the service low enough to get the power business would bankrupt us. We did, however, find that by selling both lighting and power—that is, by adding the power sale to the lighting sale—we did not increase our expenses in the same ratio, because a lot of our work and plant could serve both light and power at no more cost than if we served only lighting alone.

"We found that if we made a power price different from the lighting price, and made the power price less than the traffic would bear, then we got both the lighting business and the power business, and in fact found we could make the price of each lower than if we sold only lighting, and lower than if we sold only power."

The same principle was in turn applied to obtain hotel, drugstore, big wholesale and other business, and as a result of its operation the price of lighting to small consumers, Mr. Hale said, had been reduced to one-tenth of what it originally was and perhaps to one-half of what it would be if there were no power rate, no long-hour rate, no wholesale rate or, finally, no heating rate. With special regard to the latter Mr. Hale said:

> Our heating rate is figured, as nearly as we can tell, so as never to be such that the traffic will not bear it. If we should make a rate for heating whole houses in order to compete with coal we should have to make a rate of about 5 mills a kilowatt-hour; but as it costs us nearly a cent for the coal alone for each kilowatt-hour we add to our output, we cannot compete for house heating. For heating bathrooms, however, and for making ice and for cooking food, we find that, though this kind of service can't pay our lighting rate or even our power rate, yet people can afford to heat bathrooms when they want the heat for only a quarter of an hour or so, and they can afford to use electric refrigerators, etc., at a rate lower than our power rate, and yet not so low but that we can supply the service and make more profit on the resulting total business than we could make if we charged more than the traffic would bear, in which case we would not get the business at all.

Some people—for instance, the power people—say, "Why

can't we have the heating rate?" The answer is that if we are going to cut rates for any reason other than because we have to make a low rate to get business like the heating business, then it is not the power people alone who should get the cut, but it is our small customers who depend on us. If we can afford a cut to our existing business, it goes to the small customer.

In making the heating rate we try to make the rate so that we shall get the business; in other words, we try to make the heating rate so that the customers who want electricity for heating shall take our service and yet have a good profit left after they have paid our bills and all their other expenses.

Now, we may make mistakes, and, further, we cannot always classify as exactly as we should like to. For instance, a case could be made out that we ought to sell energy for melting steel at a lower price than for melting brass, just as we now sell energy at a lower rate for melting brass than for driving a machine-shop motor, but to go into these complications would, we think, not be practicable —at least not now.

We have designed our heating rate so that, in our opinion, the people who want heating can—at least most of them or a great many of them—take electric heating at our heating rate, and they can, we hope and think, make more money than they can if they don't take our service.

Allowing the Customer to Read the Meter

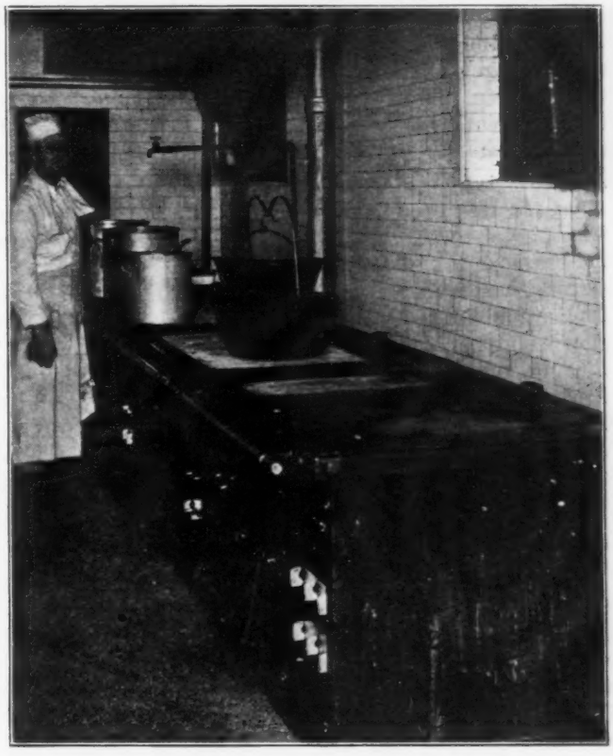
SEVERAL of the power companies on the Pacific Coast that have a large number of rural customers have adopted the system of leaving a post card for the customer to fill out and return with his own meter reading. The Washington Water Power Company at Spokane sends out post cards monthly to suburban districts, and the meter reader does not then revisit these districts until spring. The results have been found very satisfactory. The Wenatchee (Wash.) Valley Gas & Electric Company has followed this practice since 1911 throughout its rural districts. Some of its customers live forty miles away from headquarters, and regular methods of meter reading have been found out of the question. By the present practice the cards are sent monthly. It has been found that, although occasional delays occur, on the whole cards are returned promptly. The company then sends out a statement based upon this reading, which is returned with a check covering the amount due.

This practice is also followed by the Puget Sound Traction, Light & Power Company, at Seattle, Wash. This company not only finds it satisfactory from the accounting standpoint but thinks that it helps to establish confidence in the minds of the customers as to the company's integrity. It practically does away with complaints of bills being too high. Customers' readings are also frequently accepted for final bills, particularly in cases where the customer calls up to report that he is leaving town. In many instances the customers are asked to give the readings of their meters over the telephone. If they do not understand how to read a meter, this is briefly explained to them and the result of their reading is then compared with that of the previous month. The amount of the bill is given them over the telephone, and the check sent the next day is accepted as final payment. This plan has worked out very well, and the company feels that it has many accounts that have been paid at once which might have cost time and money to collect later had another system been in use.

Data on Electrically Operated Cafeteria in Louisville

EXPERIENCE with an electrically operated cafeteria in Louisville, Ky., indicates that it is turning out to be a money maker not only for the local central station but also for the proprietor. The restaurant is open from 7:30 a.m. to 9 p.m., serving three meals per day. It is operated on the self-service plan and is serving about 3,000 meals per day. According to its manager, the average customer's check is about 65 cents. This would show receipts of about $1,950 a day.

The electrical heating installation consists of the following equipment: Four hotel-type ranges, 22 kw. each;



FOUR HOTEL-TYPE ELECTRIC RANGES HAVING A TOTAL RATING OF 88 KW.

two bake ovens, 25 kw. and 5 kw. each; one griddle-cake baker, 6 kw., and one electric toaster, 3 kw., or a total of 149 kw.

This heating and baking equipment has shown an average monthly demand of about 100 kw., and an average monthly energy consumption of about 25,000 kw.-hr. Under these conditions the cafeteria earns an electric rate of about 1.8 cents per kilowatt-hour on the electric cooking load. According to these figures the cafeteria owner pays the electric company about $450 a month for energy for electric cooking.

The original installation cost the cafeteria owner about $4,000, most of the electric heating equipment being furnished by the Hughes Division, Edison Electric Appliance Company. This first cost, however, does not include the cost of installation. The cafeteria owner is very well pleased with the installation, particularly in view of the fact that it enables him to use basement space for his kitchen without having to contend with disagreeable fumes such as arise from other fuels where the kitchen is in the basement.

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Soldering of Short-Circuit Rotors.—In small and medium-sized induction motors, where the rotor bars are directly soldered to short-circuiting rings, much trouble is experienced by centrifugal action throwing out the soldering alloy, which is often heated to its melting temperature during start and when the load suddenly changes. According to a method used in the Bréguet factories, the soldered joints are covered by a thin capsule of copper, applied by means of the Schoop metallization process. Even though the solder may melt, it is thus prevented from escaping, and, upon cooling, it forms again a reliable joint.—*Revue Générale d'Electricité*, Nov. 8, 1919.

On the Use of Commutators in Alternating-Current Machinery.—L. GRATZMÜLLER.—The author analyzes the development of polyphase alternating-current commutator machines of various kinds, and discusses the application of the commutator to such problems as alternating-current motor-speed variation, phase advancing, and compounding of synchronous and induction generators. Considerable stress is laid upon historic development, and much attention is given to certain questions of patent priority in the field.—*Bulletin de la Société Française d'Electriciens*, July 1919, and *Revue Générale d'Electricité*, Nov. 15, 1919.

Lamps and Lighting

A New Mercury-Arc Lamp.—HENRI GEORGE.—One of the difficulties in utilizing the high efficiency of the mercury arc for lighting purposes (about 0.2 watt per candlepower) is the necessity to provide special means for starting the arc. Another disadvantage of the ordinary type of mercury lamp is the slow increase of pressure in the bulb and the resulting gradual approach to full intensity of light. The author describes a mercury-arc lamp of novel design which is completely automatic and attains stable conditions very quickly. The arc is formed between mercury electrodes in an atmosphere of helium, argon or neon at approximately atmospheric pressure, and therefore is of high brilliancy. Before starting the lamp the tube is filled with mercury which forms a metallic path through the lamp. The current rush heats a tungsten filament to incandescence, and when heat is transmitted from the filament to a gas chamber the expanding gas will drive out the mercury from the tube so that an arc is formed. The lamp is built for 110 volts direct current and the starting current is 11 amp., which in thirty-five seconds decreases to 6 amp. It is claimed that it is rugged enough to withstand severe handling.—*Revue Générale d'Electricité*, Dec. 6, 1919.

Improving the Automobile Headlight Lamp.—L. C. PORTER.—It is pointed out that lamps intended for use with lens systems or parabolic reflectors must have the light source placed along the axis, usually at the focal point. Manufacturing methods must be adopted which will insure uniform dimensions in lamps of a given type, in order to make quick satisfactory replacements. In this article are described manufacturing methods of making automobile headlamps stage by stage, indicating what is being done to secure a product as nearly uniform in dimensions and performance as possible.—*General Electric Review*, January, 1919.

Generators, Transmission and Distribution

Fusibility of the Coal Ash from Eastern Coals.—W. A. SELVIG, O. C. BROWN and A. C. FIELDNER.—Tables are given showing the fusing temperatures of the ash for coal mined in certain sections of the Eastern coal provinces, the sections chosen being parts of Ohio, Virginia, Kentucky, Maryland, Tennessee and Alabama. It is pointed out that the property of high fusing temperature of the ash is of great importance to the users of the coal and that the Maryland coals owe their high market values quite largely to the high temperature with which their ashes fuse.—*Coal Age*, Jan. 22-29, 1920.

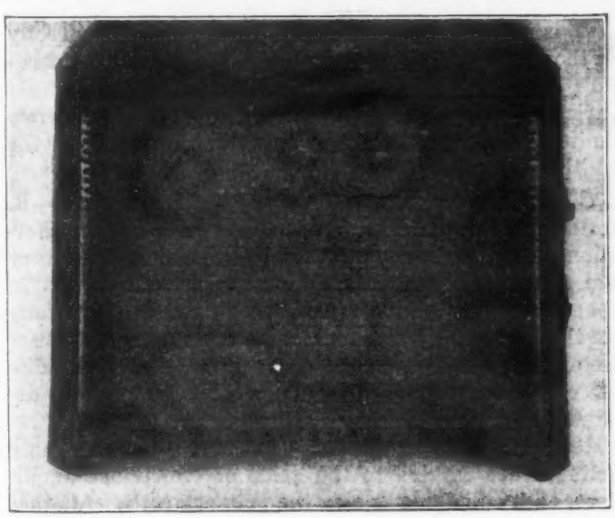
A National Power Distribution Project.—F. SCOUMANNE.—It is a huge project which the author here draws up as a suggestion for future power transmission policy in France. A complete consolidation of all power resources is proposed, under the direction of a central financial organization. Hereby all the advantages of diversity of load and high efficiency of the large central station could be combined with the benefits to be derived from interconnection between plants, co-operation in the matter of fuel purchases and transports, rate making, etc. In discussing the economical advantages of centralization in electric power generation the author shows by means of curves and examples how first cost per kilowatt decreases with increasing station capacity. The moment is said to be opportune for discussing a consolidation, since rebuilding of industry in the devastated areas and future railroad electrification will require great extensions in the present power distribution systems. Although the state would be the biggest customer of the proposed power system, complete state control, in the author's opinion, would not be desirable, primarily for the reason that a state-governed institution never can fully utilize the advantages of individual bargaining.—*Revue Générale d'Electricité*, Nov. 1, 8 and 15, 1919.

Traction

Calculation of Ground Currents Due to Direct-Current Electric Railways.—GIROUSSE.—The complexity of the ground-current distribution problem in case of railways with track return where many feeders are present makes a direct solution of the problem difficult to obtain. According to a semi-graphical method suggested by the author, the elementary current distribution, due to each feeder and each railway, is separately studied, the actual state of affairs being obtained by superposing a number of elementary solutions. The current distribution is defined by the track potential, which follows a hyperbolic cosine function of certain variables, proportional to track distance.—*Comptes Rendus*, Nov. 10, 1919.

The Power Indicating and Limiting Apparatus for the Chicago, Milwaukee & St. Paul Railway.—B. H. SMITH.—The writer deals with the method of keeping the dispatching office in touch with the power being supplied at the various substations along the Coast and Columbia divisions of the Chicago, Milwaukee & St. Paul Railway. The dispatcher's office is near Tacoma at the western end of the division. At the easternmost substation there is a 1-kw. generator which produces a current with frequency so controlled that it varies with the power as measured by the wattmeter at the substation. The voltage generated is stepped up to 2,000 and transmitted to the next substation about 100 miles (160 km.) to the west. Here the frequency is not increased directly, but another alternating-current generator is introduced and so controlled that its speed and frequency are proportional to the power being measured at both of the substations. This process is repeated until the indication at the load dispatcher's office gives the total of all power received by the electrified section of the road. Since the railroad buys energy on the basis of a maximum five-minute integrated load, it is necessary to keep the peak loads as low as possible. This is accomplished through the agency of a load regulator which, when it reaches a predetermined point, closes its contacts in the lowering direction and sends out to the substations a direct current which acts on the field rheostats of the generators to reduce the normal 3,000 volts at the trolley at times of heavy overload.—*Electric Journal*, February 1920.

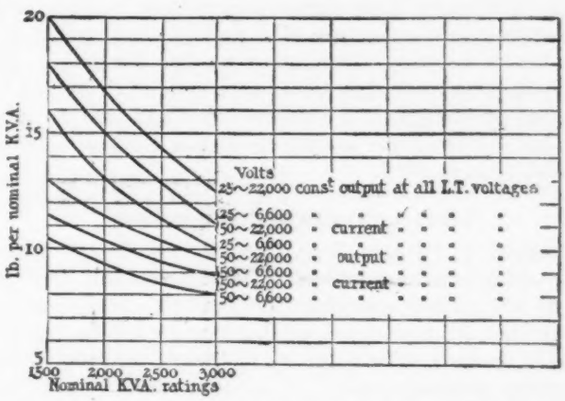
Present-Day Radiography.—G. W. C. KAYS.—The writer calls attention to the great stimulus given to the use of X-rays for surgery during the war. A new branch of radiography has been developed within the last year or two in the application of X-rays to the



RADIOGRAPH OF ELECTRICALLY HEATED EARTHENWARE COFFEE POT

study of materials and structures. For this purpose it is said that the Coolidge tube is by far the biggest step in the progress in X-ray work. A number of examples are given of the use of X-rays in examining the internal structure of engineering materials.—London *Electrician*, Feb. 6, 1920.

Transformers for Electric Furnaces.—J. L. THOMPSON.—This is a comprehensive discussion of the present and future status of transformers for electric furnace work. The author states that at the present time electric steel furnaces have been designed for capacities of 15 tons and that the future will demand larger sizes up to 30 or 40 tons. Assuming that 200 kva. is required per ton, transformer groups of 6,000 kva. to 8,000 kva. will be required. While transformers of larger capacities have been designed, this particular problem is complicated by the low voltage and heavy currents required. The writer then deals with the design of the furnace with special regard to the heavy magnetic fields involved, the mechanical stresses and



APPROXIMATE WEIGHT OF FURNACE TRANSFORMERS

furnace layout. He states that in order to reduce the possibility of a heavy choking effect and unbalanced voltages, the following suggestions may be useful: (1) Transformers should be placed as near to the furnace as possible, so that heavy low-voltage leads may be of minimum length. (2) Low-voltage leads of the various phases should be symmetrically placed with respect to transformers and furnace. (3) The area between positive and negative low-voltage leads should be as small as possible and also that between phases so that inductance may be a minimum. (4) Low-voltage leads for heavy currents (above 5,000 amp.) should be in multiple and interleaved from the transformer to a point as near the furnace as possible. This will keep the inductance low and make that of each lead approximately the same, thus insuring that each parallel lead takes its proper share of the load. (5) Heavy current leads should not be run near any heavy magnetic structure such as girders or supporting columns unless both the positive and the negative leads are run together and interleaved. (6) No magnetic material should form a closed circuit around any positive or negative conductor, or heavy currents will be induced in that circuit. The positive and negative conductors interleaved may be run through a magnetic circuit. Clamps for heavy-current leads should be of nonmagnetic material.—London *Electrician*, Jan. 30 and Feb. 6, 1920.

Electric Mine Hoists.—G. HACAULT.—In the last installment of this extensive series of articles, the earlier parts of which we have already referred to in these columns, the author takes up for discussion the various systems of direct application of alternating-current motors for driving the hoist drums. In Europe the induction motor is only seldom used for high-power hoists, owing to the difficulties of adapting it for reliable regenerative braking. During later years, however, the alternating-current commutator motor has come into extensive use in this field, in units up to many hundred horsepowers. A popular type is the Deri

motor, which works as a repulsion motor, having its stator connected directly across the mains, while the wound rotor is electrically isolated and provided with two mutually interconnected sets of brushes, one of which is movable with respect to the other. All adjustments of speed are made by moving the second set of brushes, and a very reliable regenerative braking is thus obtained. For three-phase supply bigger units are built as double motors, having two independent armatures and two Scott-connected stators for balancing the load. Ordinary three-phase commutator motors with armature-transformer are also rapidly coming into use for heavy hoisting. Summing up the foregoing discussion, the author states that each type of drive has its decided advantages and disadvantages and that no rules can be laid down for a choice.—*Revue Générale d'Electricité*, Nov. 8, 1919.

Electrophysics and Magnetism

Theory of Vacuum-Tube Oscillators.—ANDRÉ BLONDEL.—In a previous article (*Comptes Rendus*, Oct. 20, 1919) the author considers the limiting conditions for occurrence of undamped oscillations in triode circuits and, in analogy with singing-arc theory, introduces the "dynamic characteristics" of vacuum tubes. On a similar basis the present paper attacks the more general problem of predetermining the amplitude of the oscillating current. For this purpose the curvature of the characteristic surface of the tube is taken into account by considering the higher partial derivatives, and solutions are obtained in the form of Fourier series for the oscillating current and its harmonics in the simple case of a triode oscillator with tuned plate circuit.—*Comptes Rendus*, Nov. 24, 1919.

Methods for Computing and Intercomparing Radiation Data.—W. W. COBLENTZ.—This paper gives a simple method for computing spectral energy curves, using the Planck formula . A table of values of log (s^u—1) is given. There is also a chart for intercomparing thermal radiation constants with similar data obtained indirectly from photoelectric X-ray and ionization potential measurements.—*Scientific Paper* No. 360, *U. S. Bureau of Standards*, Jan. 21, 1920.

Electrochemistry and Batteries

Report of the Nitrogen Products Committee.—In this report the committee points out the fundamental importance of combined nitrogen in agriculture and munition work and gives a short account of the various nitrogen recovery and fixation processes. In dealing with this subject the committee adopted pre-war conditions as the best basis as far as costs and prices are concerned, and it is noted that the figures for cost represent pre-war production costs at factory and do not include any allowance for interest, marketing or profits, although the cost of electrical energy in all cases is taken as inclusive of capital charges upon the power installation. In conclusion it was said that the committee is satisfied that synthetic processes can at the present time be economically carried out in the United Kingdom. As regards nitrogen fixation in the British Empire generally, the ideal policy would be to make the British Empire independent of external supplies of all nitrogen products, and the investigations of the committee indicate that it is practicable. Canada, it is said, possesses exceptional water-power resources capable of easy development at a cost probably as low as or even lower than that of the very cheapest Norwegian powers, while in New Zealand, Tasmania, Egypt and India the method of synthetic nitrogen products can be profitably undertaken. In places where very cheap power can be developed nitrate fertilizers might be manufactured at a price that would compete with that of Chilean nitrate, while in other places where high-grade limestone and anthracite could be obtained the calcium-cyanamide process might prove the best—London *Electrician*, Jan. 23 and 30, 1920.

The Resistance of an Electrolytic Cell.—EDGAR NEWBERY.—The writer points out that the resistance of an electrolytic cell is made up in two parts, the resistance of the electrolyte and the transfer resistance from electrode to electrolyte. It is the transfer resistance which is studied particularly in this article.—*Transactions Faraday Society*, December 1919.

Units, Measurements and Instruments

Thermostatic Metal.—HENRY HERRMAN.—It is said that until recently German-made thermostats had some advantages over those of American makes, especially in that they developed a duplex metal with an absolutely homogeneous joint, the two metals being alloyed at the junction point so that no movement of the metals was possible. Recently, however, thermostats have been devised in this country which are fused at the junction point and offer a deflection per degree 18 to 20 per cent greater than that of the foreign product. The characteristics of this thermostat as deduced from careful laboratory tests are given in brief as follows: (1) Deflection upon temperature change varies inversely as the thickness, varies as the square of the length, is not affected by changes of width and varies directly with degrees temperature change. (2) Force exerted upon temperature change varies as the square of the thickness, is not affected by changes in length, varies directly as the width and as the square of the degree temperature change. (3) Weight required for permanent set varies as the square of the thickness (between narrow limits), inversely as the length and directly as the width.—*General Electric Review*, January 1920.

On the Use of Triode Tubes in the Laboratory.—K. HOHAGE.—Not only for signaling purposes are the thermionic tubes of ever increasing importance, but they are also being applied to a diversity of problems in connection with electrical measurements. As an example the author describes an alternating-current potentiometer, where two currents of exactly 90 deg. phase displacement are employed to induce a voltage of any desired phase in a secondary, rotating coil. From a resistance-capacity bridge of usual type quarter-phase voltages are carried to the grids of two triode amplifiers, each supplying one of the primary coils. Another useful innovation is the triode voltmeter. An alternating emf. is impressed upon the plate circuit of a three-electrode tube, and at a certain grid polarization the change in plate current is observed. The direct-current milliammeter in the plate lead thus can be calibrated so as to read alternating-current volts. The triode voltmeter has been employed by the author in investigations on telephone repeating coils, receivers and transmitters, and it is claimed that by use of this instrument in conjunction with a so-called "standard ear" the lack of objectivity inherent in measurements based upon oral comparison could be eliminated.—*Helios*, June 22 and 29, 1919.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

Conference Club to Elect New Members Next Week

MEMBERS of the Conference Club, which in January adopted the idea of dedicating itself to the electrical industry, will meet in the Cleveland Hotel, Cleveland, Ohio, on March 18, to elect new members from the unrepresented branches of the industry and also decide where the next meeting will be held. There is some question whether the meeting should be held in May in California, about the time of the National Electric Light Association convention and the jobbers' meeting, or later at White Sulphur Springs or Hot Springs, Va.

As a result of this Cleveland meeting the club can get fairly launched on its new program. It will then be possible to appoint the composite committee on bylaws.

Associated Manufacturers to Hold Annual Meeting

ARRANGEMENTS have now been satisfactorily completed for the fifth annual meeting and banquet of the Associated Manufacturers of Electrical Supplies, to be held at the Waldorf-Astoria, New York City, March 18. The business session will be held in the afternoon in the Waldorf apartment, at which time a review of the work of the year as covered by reports of officers and standing and special committees will be presented. The election of five new members to the board to succeed retiring governors will also take place. In the evening the annual banquet will be held in the Astor Gallery.

New Coast Electrification of Chicago, Milwaukee & St. Paul Opened

FRIDAY morning of last week the Olympian train left Seattle over the Chicago, Milwaukee & St. Paul tracks for Chicago, marking the opening of service on the newly electrified coast division of the system, which adds 207.4 miles to the 440 miles previously electrified in Montana. The coast division extends from Tacoma, Wash., to Othello, Wash. Between Othello and Avery, Idaho, the western end of the Montana electrification, there is an unelectrified stretch of 212 miles.

Electrification of these lines releases, or will release when it is completed and the Avery-Othello gap closed, about 250 steam locomotives and will employ in their place from ninety to ninety-five electric locomotives. Substitution of hydro-electric power for steam on the system will, when completed, mean a saving in fuel, based on the business of 1918, of approximately 300,000 tons of coal and 40,000,000 gallons of fuel oil annually.

The power furnished to the Milwaukee lines for the newest electrified section is taken for the Snoqualmie plant of the Puget Sound Traction, Light & Power Company at the west end near Seattle and from the Long Lake plant of the Washington Water Power Company on the Spokane River. Energy is delivered to the railroad's transmission lines along its right-of-way at 100,000 volts. There are eight step-down substations between Othello and Tacoma from which direct current is fed to the locomotives at 3,000 volts.

The first electrification of the lines of this system was put into operation in December, 1915. It was the Rocky Mountain division of 226 miles. The following year the Missoula division of 211 miles was placed under electrical operation.

Electric Service Lines Withstand Severe Blizzard

IN WHAT was characterized as the most severe blizzard, while it lasted, in years, the transmission and distribution lines of electric light and power companies in the East stood up almost 100 per cent. The blizzard, which visited the Western and Middle States in the early part of the week, reached the Atlantic coast on the night of March 5. Heavy rain was followed by sleet, hail and finally snow, accompanied by wind which reached a velocity of 72 miles an hour. Traffic was blocked and trains were stalled either in snowdrifts or by washouts from floods caused by the rain early in the evening.

Telephone and telegraph lines were put out of service, a district manager of the telephone company in New Jersey stating that this was the worst storm his company had experienced in the past ten years. The electric companies probably suffered the least of all utilities. The New York Edison Company stated that the storm caused no interruption of service in New York City, and in Yonkers but one circuit was out, for a period of only fifteen minutes. The Public Service Company of New Jersey, the Brooklyn Edison and the New York and Queens company each reported practically no trouble other than on one or two series incandescant street-lighting circuits. The Richmond Light and Railroad Company (Staten Island) stated that a few poles had been blown down but service was maintained.

In New England a few lighting circuits were reported down in outlying districts, but in no case was the number of customers affected very large.

Detroit Edison Issues $5,503,500 Ten-Year Debentures

THE Detroit Edison Company is issuing $5,503,500 ten-year 7 per cent convertible debenture gold bonds These bonds will be convertible at the option of the holder into paid-up shares of the capital stock of the company at par.

The proceeds of this issue, as stated by F. H. Fiske, assistant secretary of the North American Company, will be used for the development, extension and maintenance of the Detroit Edison Company.

News in Brief

SUMMARY

of Important Happenings in the Industry During the Week

SHORTAGES in stocks are worse, but the outlook is better. Improved weather conditions are expected to release more materials through betterment of transportation. The existing demand is very heavy, and increased purchases are being urged in some centers. The building program is getting under way, though there is still uncertainty about many projects. High prices are not being paid with the readiness of a few months ago.

METALS generally have shown a falling off in price in the last week. Copper dropped another quarter of a cent. Antimony and zinc also eased off slightly, while tin continues its downward plunge.

JOBBERS in New England were unable to receive goods or make deliveries outside their immediate centers of location last week with very few exceptions, owing to the severest weather conditions in many years. Central-station service, however, was well maintained, and confidence is felt that the worst of the fuel shortage is over.

EXPORT trade in electrical goods continues to fall off, the figures for January dropping to $6,347,497, which is lower than any month since September last and about 5 per cent lower than for January, 1919.

MOTOR prices moved upward Monday from 5 to 10 per cent in the case of units of 30 hp. and below manufactured at the Lynn works of the General Electric Company.

INDUSTRIAL plant construction is going forward in New England at a record-making pace, reflecting great confidence in the future.

SUBSTANTIAL increases of salary are granted to the employees of the Patent Office by a bill which has passed the House of Representatives.

WHOLESALE sale of electrical energy by street railways was vigorously opposed by central-station interests at a recent hearing given in Boston by the legislative committee on public lighting.

COMMITTEES similar to the Illinois Committee on Public Utility Information have been established in Indiana, Kentucky, Michigan and Minnesota, and one is being organized in Iowa.

STARTLING figures were made public at a conference of public officials in California held to consider the low-water situation and consequent shortage of power. The reservoirs of the state have only one-tenth last year's supply.

A TRAVELING representative is now covering the country to help build up the state and local bodies of the National Association of Electrical Contractors and Dealers.

THURSDAY of next week has been fixed as the date for the fifth annual meeting and banquet of the Associated Manufacturers of Electrical Supplies.

AS A RESULT of a meeting to be held in Cleveland next Thursday the new co-operative program of the Conference Club is expected to be fairly launched.

ELECTRIC refrigeration and industrial heating were discussed at a meeting of the Commercial Section of the Indiana Electric Light Association held at Fort Wayne.

SIXTEEN California power companies and the city of Los Angeles have signed an agreement requesting the Railroad Commission of that state to assume control of the distribution of electricity in the crisis caused by the drought, and an emergency water conservation conference has been formed under the commission's auspices.

THE NEWLY electrified section of the Chicago, Milwaukee & St. Paul Railway, which was opened on Friday of last week, extends from Tacoma to Othello, Wash., a distance of 207 miles.

AT A SPECIAL meeting of the Western Association of Electrical Inspectors' technical sub-committee on wireless-telegraph systems amendments to Rule 86 of the National Electrical Code, on radio signaling, were tentatively approved.

CONGRESSIONAL conferees on the water-power bill have again adjourned, to reconvene in two weeks. Friends of the measure are reported as satisfied with the progress made. The chief contention has been over the provisions relating to license charge and recovery.

LIBERAL arrangements for company insurance of employees have been made by the Westinghouse Electric & Manufacturing Company.

TEN-YEAR 7 per cent convertible debenture gold bonds are being issued by the Detroit Edison Company.

ELECTRICAL safeguards for the coal mines of Pennsylvania were discussed at a conference of public officials, coal operators and electrical manufacturers held in Harrisburg.

A BLIZZARD, characterized as the most severe for years, failed to disorganize the electric service lines of the East, although railroad and street traffic was blocked and telegraph and telephone lines put out of service.

A PLAN for the consolidation of Westinghouse, Church, Kerr & Company with Dwight P. Robinson & Company has been submitted to the stockholders of the former.

A LARGE attendance, many from out of the state, marked the convention of the Oklahoma Utilities Association at Oklahoma City.

DAYLIGHT saving is favored in many Middle West cities, including Chicago, Minneapolis and Aurora, Ill.

RAINFALL in California for January was 18 per cent and for February 15 per cent normal.

APPLICATIONS for water power amounting to 450,000 kw. have been received by the Oregon State Engineer since Jan. 1.

PLANS are being asked by the Southern California Edison Company for an additional 30,000-kw. steam turbine at its Long Beach plant. The company is increasing the storage capacity of Shaver Lake to allow production of an additional 46,000,000 kw.-hr. a year and is also starting work on Big Creek power house No. 8 as an emergency measure to furnish 100,000,000 kw.-hr. during 1921, with an installed capacity of 22,500 kw. to be furnished by the spring of 1921.

A LARGE factory is to be built in Oakland, Cal., by the Apex Appliance Company of Chicago to manufacture electric washing machines and other electric appliances.

PERMISSION to raise its rates on its industrial load is asked by the Utah Power & Light Company in order to meet a deficit of from $2,000,000 to $5,000,000.

CAPITAL stock of the Cleveland Electric Illuminating Company has been increased from $18,000,000 to $30,000,000.

Westinghouse Gives Insurance to Employees

COMMENCING March 1, an insurance policy for the sum of $500 will be given without cost to every employee of the Westinghouse Electric & Manufacturing Company who has been in the service of the company for a period of six months or more, according to a statement made this week by one of the officials of the company.

In addition, the employees, after April 1, may increase the value of their policies to amounts varying from $1,000 to $2,000, depending upon their length of service and continuity of savings. All employees who have been in the company's service for six months or longer and who deposit a sum each pay day in the employees' savings fund equal to 2 per cent or more of their earnings will not only receive 4½ per cent interest compounded semi-annually on such deposits but in addition will automatically have their insurance increased to amounts up to $2,000, depending on the length of time they have been with the company.

After an employee has maintained the required deposits for a period of five years he may discontinue or withdraw his deposits from the savings fund without in any way affecting the value of his insurance policy.

This insurance is to be made effective at all of the various offices and plants of the Westinghouse company and will affect approximately 50,000 people.

Water-Power Conferees Again Adjourn

WITH only two major points of difference between them, the conferees on the water-power bill adjourned March 9 without having reached an agreement. No further sessions of the conference committee will be held for two weeks, in order to await the return to Washington of Representative Taylor of Colorado and to give Senators Jones and Smoot an opportunity to go ahead with their work on other bills.

Prompt agreement may be expected on the reconvening of the conference committee, it is believed. Friends of water-power development regard the situation as very satisfactory. There had been some hope that the conferees would get together after a short discussion, but this was not realized. The items which have delayed agreement are those pertaining to license charge and recovery.

The conferees decided to eliminate the power project at Great Falls on the Potomac River. That project was placed in the bill in the Senate and carried an appropriation of $25,000,000. In its stead the following amendment was adopted:

"The commission is hereby authorized and directed to investigate and, on or before the first day in January, 1921, report to Congress the cost and, in detail, the economic value of the power plants outlined in Project No. 3, House Document No. 1400, Sixty-second Congress, third session, in view of existing conditions, utilizing such study as may heretofore have been made by any department of the government; also, in connection with such project, to submit plans and estimates of cost necessary to secure an increased and adequate water supply for the city of Washington. For this purpose the sum of $25,000 or so much thereof as may be necessary is hereby appropriated."

No announcement was made with regard to conclusions on other items, but it is believed that the Newlands investigating provisions will be eliminated. The opposition to having an army engineer as the executive secretary probably will be met by placing a civilian in that office with the authority to have an engineer officer detailed to assist in the work.

The principal discussion between the conferees, it is understood, centered on the Senate amendments numbered 28, 31, 44, 45 and 46. In the provision of the bill referring to the transfer of licenses the House measure was amended by the Senate to the effect that no voluntary transfer of any license or of the rights granted under it "by sale, assignment, consolidation, merger or otherwise" shall be made without the written approval of the commission. The Senate change is causing some trouble.

The Senate's amendment No. 31, another bone of contention, was a proviso to the effect "that the United States may have the option to redeem such site or sites by payment to the proper persons holding such title, under and by virtue of said mortgage, trust deed, judicial sale or tax certificate, of the entire amount due at the time such option applies for a period of one year from the date such right or title is secured, and if said option is acted upon, all rights to said lease or license shall revert to the United States."

Considerable controversy is understood to have taken place in regard to paragraph "J" under the section of the bill which specifies what each applicant for a license must submit to the commission. That paragraph, which was added by the Senate, reads as follows:

The licensee hereunder shall not directly or indirectly discriminate or permit discrimination in the apportionment, allotment, transmission, distribution, sale or lease of power or electrical energy or current in favor of any municipality as against any other or others in respect of service, rates or the quantity of power or electrical energy or current transmitted or supplied to it or them; but the licensee shall fairly and equitably apportion, allot, transmit and supply power, electrical energy and current among and to such municipalities as can be efficiently served and supplied directly or indirectly by the licensee in proportion, so far as practicable, to their respective populations, industrial or commercial importance and prospects, needs and requirements, so as best to subserve the public interests. This condition shall be binding upon every person, association and corporation receiving power or electrical energy or current from the licensee and engaged in developing, transmitting, distributing, selling or leasing power, electrical energy or current to any municipality or to its inhabitants, and shall inure to the benefit of such inhabitants. Every contract, agreement or understanding between the licensee and such person, association or corporation shall be expressly subject to and limited by the provisions of this subsection. This condition may be enforced and regulated by the commissions or other agencies mentioned in, and in the manner and to the extent prescribed by, Section 19 of this act.

In the section of the bill providing for the construction of locks in navigable streams, the Senate, in its amendment No. 45, struck out the provision that the commission "may, before taking action upon such application, cause a report under such project to be prepared, and inserted a provision that the commission "shall take no action but" cause a report to be prepared. This change does not meet with favor on the part of the House conferees.

The most acrimonious discussion is understood to have waged around amendment No. 46, pertaining to severance damages.

Prominent Engineering Houses to Consolidate

A PLAN for the combination of Westinghouse, Church, Kerr & Co., Inc., with Dwight P. Robinson & Co., Inc., was submitted on March 2 to stockholders of the former. It is proposed to form a new company, under the Virginia law, to be called Dwight P. Robinson & Co., Inc. Including the holdings of the Westinghouse Electric & Manufacturing Co., the plan has the approval of 61 per cent of the Westinghouse, Church, Kerr stock.

Westinghouse, Church, Kerr & Co., formerly the Electric Properties Corporation, was formed in 1884, when the electrical industry was just starting. It was organized to do a construction and engineering business and engage in financing public utilities.

The Westinghouse Electric & Manufacturing Co. is the engineering company's largest stockholder, and the two companies have been closely identified in the eyes of the public. Because of the belief on the part of prospective clients of the engineering company that it would expect to use Westinghouse equipment in any construction, the engineering company, it is stated in the plan, has been handicapped in procuring business. It appears that it would be to the interest of both companies to terminate the association. It was thought best therefore to associate the company with any established engineering and construction company, and with this end in view this consolidation was proposed.

Dwight P. Robinson & Co. was organized in 1918 by Dwight P. Robinson, who for the past twenty-five years has been engaged in engineering and was for many years president of the Stone & Webster Engineering Corporation. It is stated in the plan that when Mr. Robinson formed his company the Westinghouse Electric & Manufacturing Co. and Guy E. Tripp, chairman of the board of the Westinghouse company, among others, became minority preferred and common stockholders, having in view that such an interest might later tend to bring about a union or merger such as is now proposed.

It is stated that the two organizations have supplementary experience and that the combination will absorb the entire personnell of the two companies. Dwight P. Robinson & Co. has been primarily engaged in power-plant construction, while the chief field of Westinghouse, Church, Kerr & Co. has been railroad and industrial construction work. The former company has on hand uncompleted construction contracts of approximately $14,000,000, and the latter company's uncompleted work under contract amounts to $8,000,000.

Traveling Representative for Contractorss' Association

AS A PART of its program to increase membership and to keep members in better touch with work at headquarters in New York the National Association of Electrical Contractors and Dealers has again, after a lapse of about six years, put a special representative into the field who will travel continuously. Laurence W. Davis has been engaged in this work since the first of February. He is now traveling in the New England States, after which he will cover the Western States.

Last year the national association increased its membership by 15 per cent, and since the first of the year it has added sixty-three new members. This brings the list up to virtually eighteen hundred members.

Proposed Revision of Electrical Code or Radio Signaling

AT A SPECIAL meeting of the technical sub-committee on wireless telegraph systems of the Western Association of Electrical Inspectors the following amendments to Rule 86 of the National Electrical Code were approved tentatively.

The proposed revisions to the code were made by Alfred N. Goldsmith, secretary of the Institute of Radio Engineers, and Mr. McNicol. The electrical committee will meet in New York for the code revision on March 22-25. Prior to that any comments on the proposed revision should be sent to William S. Boyd, 175 West Jackson Boulevard, Chicago, Ill.

PROPOSED REVISION OF RULE 86 NATIONAL ELECTRIC CODE.

(Note.—These rules do not apply to radio signaling apparatus installed on shipboard.)

In setting up radio signaling apparatus all wiring pertaining thereto must conform to the general requirements of this code for the class of work installed and the following additional specifications:

(a) Aërial supports to be constructed and installed in a strong and durable manner. Aërial conductors and wires leading from same to ground switch must be supported firmly on approved insulators such as porcelain knobs of approved design or petticoat insulators. Insulators must be so mounted as to maintain the conductors at least 5 in. clear of the surface of the building wall. In passing the aërial conductor through the side of the building a continuous tube or bushing must be used. The bushing or tube must be composed of non-combustible, non-absorptive insulating material and must extend 5 in. beyond the surface of the wall on both sides. The ground switch shall be mounted so that its current-carrying parts will be at least 5 in. clear of the building wall and located preferably in the most direct line between the aërial and the point of ground connection. The conductor from ground switch to ground connection must be securely supported.

(b) Aërial conductors must be effectively and permanently grounded at all times when station is not in operation by a conductor the periphery of the cross-section of which is not less than ¾ in. The ground wire must be of copper or other metal which will not corrode excessively under existing conditions. Ground connection should be made in accordance with the requirements of Rule 15A, Sections (o) to (t) inclusive, except where variation from these requirements may be allowed by special permission in writing.

(c) In radio stations used for receiving only, the grounding switch may be replaced by a similarly mounted and grounded short-gap (⅛ in. or less) or vacuum-type lightning arrester. The current-carrying parts of devices must be kept 5 in. clear of the building wall.

(d) Where the aërial is grounded as specified in Sections (a) and (b) the switch employed to join the aërial to the ground connection shall be a knife switch of approved design the blade of which must have a periphery of not less than ¾ in., and when open the current-carrying parts to which the aërial and ground connection wire are attached will be separated at least 5 in. The base of the switch must be of a material suitable for high-frequency service. Slate will not be approved.

(e) When supply is obtained direct from street service the circuit must be installed in approved metal or armored cable. In order to protect the supply system from high-potential surges there must be provided two condensers (each of not less than 0.5 microfarad capacity and capable of withstanding 500 volts test) in series across the line with midpoint grounded. A fuse not larger than 10 amp. capacity shall be connected between each condenser and the line wire connected thereto. Each condenser shall preferably be protected by a shunting fixed spark gap of 1/32 in. separation, or less.

(f) Transformers, voltage reducers, keys and similar devices shall be of approved types.

California Commission to Act in Drought Situation

SIXTEEN California power companies and the city of Los Angeles have signed an agreement requesting the Railroad Commission of that state to assume the responsibility of determining rules of service, and pledging themselves to abide thereby, for the distribution of electrical energy during the emergency created by a season of unprecedented drought following two very dry years. The diminution or refusal of service and the exchange of energy between power companies will be involved as well as co-operative plans for preventing waste. Under the auspices of the commission there has been formed an emergency water conservation conference composed of federal and state officials who have expert knowledge of the water resources of California and the extent of the present menace.

This conference includes the following members, all acting in their official capacities: W. F. McClure, state engineer; Frank Adams, California branch, Irrigation Investigation, United States Department of Agriculture; E. H. Heck, director of the state's Department of Agriculture; C. H. Lee, state water commissioner; H. D. McGlashan, United States Geological Survey; H. D. Butler, state power administrator; Lt.-Col. L. H. Rand, Corps of Engineers, U. S. A.; H. D. Loveland, chief hydraulic engineer, California Railroad Commission. The purpose of the conference, which is headed by E. O. Edgerton, president of the Railroad Commission, is "to secure for the power and water users of the state the greatest benefits from the available water and power and to reduce to a minimum the damage resulting from the water scarcity." A list of suggestions addressed to all large users of power or water for irrigation has been sent out and plans for the greatest care in inspection and fair apportionment of all waters are under way. A series of meetings in various cities of the state has been scheduled.

SHORTAGE FIGURES

Some startling figures were made public by the conference showing that there is every need for conservation of the state's water supply. The reserve water supply in the storage reservoirs was shown to be practically depleted, while the underground water in most agricultural regions has reached an abnormally low level. The snowfall in the high Sierras is only about 20 in. in depth, whereas the normal January fall is about 80 in. January, 1920, was stated to have been the dryest January recorded in seventy years. The rainfall averaged over the State only 16 per cent of the normal, and the principal reservoirs owned by power and irrigation companies contain only one-tenth, approximately, of what they contained a year ago. The Lake Almanor reservoir of the Great Western Power Company, which has an approximate capacity of 300,000 acre-feet, now has impounded only about 15,000 acre-feet.

Lake Huntington of the Southern California Edison Company, with a capacity of 94,000 acre-feet, has only 5,000 acre-feet impounded. The Crane Valley reservoir of the San Joaquin Light & Power Company has 1,000 acre-feet in storage as against a capacity of 50,000 acre-feet. The Feather River at Oroville, which a year ago was discharging approximately 4,000 second-feet, is now discharging only 1,400 second-feet. The Sacramento River at Red Bluff is now discharging only 5,000 second-feet; a year ago the flow approximated 10,000 second-feet. The quantity at present in the Sacramento River is only 1,300 second-feet above the lowest amount ever recorded in that stream.

Reports by large numbers of United States Weather Bureau observers show that the ground-water level is the lowest ever recorded. In the southern portion of the state the underground supplies having a comparatively small tributary area are rapidly being depleted. In some districts in the San Joaquin Valley the water level has receded to such an extent that it is below the suction limit of the pumps now installed. Regarding this feature the conference reported:

"It will be difficult to supplement the present undeveloped underground supply by the installation of additional wells because of the shortage of electrical energy, which is very serious at the present time and prevents the taking on of new consumers by the various power companies. The power companies are either refusing to take on new business or are materially restricting it; furthermore, the leading companies handling equipment for well and pumping plants have practically no stock on hand and cannot make deliveries within from six to twelve months."

Wholesaling of Energy by Street Railways Opposed

AS COUNSEL for the Massachusetts Electric and Gas Association, E. W. Burdett, appeared recently before the legislative committee on public lighting at Boston in opposition to a petition of the Berkshire Street Railway for authority to sell electricity in bulk in the general power market. The railway company's petition, he declared, endangered the whole trend of legislative practice in the state, whereby it has long been the policy to keep separate the functions of public utilities of different character and to avoid the indiscriminate granting of competitive privileges. The hearing was one of the most important in the present session.

C. Q. Richmond of Pittsfield, general manager of the Berkshire company, informed the committee that his company desired to sell energy in bulk because it has a surplus in its steam stations at North Adams and Pittsfield and no longer supplies electricity for the operation of trains through the Hoosac Tunnel. The combined generating capacity of the plants named is about 14,000 kw. The company's transmission lines traverse the county from end to end, and the witness said that the demand for power exceeds the present ability or willingness of other agencies to supply. The loss of the tunnel load has resulted in a decrease in the operating efficiency of the steam station at North Adams. The Berkshire company has been obliged to refuse industrial power business offered it. One concern wanted 1,500 kw., and had the company had the legal right it could have furnished energy to the General Electric works at Pittsfield in the desperate fuel situation of the last few weeks. The company does not desire to sell less than 300 kw. in each case of bulk supply.

For the central-station interests. Mr. Burdett pointed out that the supply of electricity in bulk is

competitive business and does not need to come under legal price regulation. It is therefore exempt from the ordinary rules in rate fixing. By Chapter 127, Acts of 1919, the Berkshire company was authorized to sell electricity to any electric company, to any municipal lighting plant or to any town in Berkshire County not already supplied with electricity; to sell to private consumers in those towns with the consent of the selectmen; to sell electricity in Blandford, outside the county, and, finally, the company received special authority to transmit for electric companies within Berkshire County electricity furnished by them for transmission to other electric companies in the county. At this point A. M. Robinson, for the Berkshire company, stated that the company had not proceeded in accordance with the act because of labor troubles and the severity of the winter.

Continuing, Mr. Burdett pointed out that if the Berkshire company desired to enter the field of power supply, it could organize a company for that purpose under the Acts of 1914, Chapter 742, and then be on the same level with every one else, subject to the regulation of the Department of Public Utilities and obliged to compete with other companies on even terms. E. C. Mason, for the Southern Berkshire Power & Electric Company, Great Barrington, Mass., also opposed granting the railway company's petition.

Heating Load Permits More Watts Per Dollar Than Motors

ELECTRIC refrigeration and industrial heating were discussed at the technical sessions of the March 4 meeting in Fort Wayne, Ind., of the Commercial Section of the Indiana Electric Light Association. The banquet in the evening was a "get-together" meeting for all the branches of the industry in Fort Wayne to hear William L. Goodwin of the General Electric Company and Samuel A. Chase of the Westinghouse Electric & Manufacturing Company.

Mr. Goodwin, after an emphatic criticism of municipal ownership, spoke of the need for investment in utilities by the local public "If everyone in the electrical industry would invest part of his earnings in central-station securities," Mr. Goodwin said, "we would all make it our business to see that the utilities were properly protected."

A paper by Robert Montgomery, commercial manager of the Louisville (Ky.) Gas & Electric Company, brought out that the average family able to buy a refrigerating machine costing $350 to $450 is paying about twice as much for ice at 50 cents per 100 lb. as it would cost to operate the machine at 3 cents per kilowatt-hour. In the discussion of the paper A. W. Shade of the Kelvinator Company, Detroit, held that energy at 10 cents per kilowatt-hour was about equal to ice at 50 cents per 100 lb.

A power customer can install twice as many watts per dollar in heating load as he can in motors, and the heating load has the additional advantage to the central station that it is balanced and has 100 per cent power factor and a very high load factor, it was contended by R. Thurman, Muncie, Ind., in his paper on "Industrial Heating." Uses for industrial electric heating were found in practically every factory in Muncie, and at the present time the customers of the central station in that city have ordered or installed a connected load of 3,375 kw. in industrial heating apparatus. M. S. Caldwell, South Bend, Ind., said that the central-station men had been depending too much upon the manufacturers of heating units to get this business for them.

Kansas Broadens Scope of Utility Law Radically

IN PLACE of the Public Utilities Commission of Kansas, which was abolished by law on Jan. 24, 1919, a Court of Industrial Relations has been established, with control over wages, working and living conditions and hours of labor in public utilities, in the mining or production of fuel, in the manufacture of food products and in the manufacture of clothing, in addition to all the powers, authority, jurisdiction and duties which were formerly vested in the commission. Any person who violates an order of the court or influences others to do so is subject to a fine not to exceed $5,000, to imprisonment up to two years, or to both.

No person, firm, corporation or association of persons shall willfully hinder, delay, limit or suspend the continuous operation of the specified industries. If it appears to the court that a controversy arising between the employers and workers may endanger the continuity or efficiency of the service of the designated industries, the Court of Industrial Relations may investigate the controversy upon its own initiative and make such orders as it believes will settle and adjust the dispute while protecting the parties, their property and the public interests.

In case the operation of any of these basic industries is suspended or limited the court may, in the interest of the public welfare, take over and operate the industry during the emergency, provided that the owners and the employees are in each case compensated on a fair basis.

Authority is given to appeal within ten days from the rulings of the Court of Industrial Relations to the Supreme Court of Kansas, and such proceedings shall take precedence over civil cases before the Supreme Court.

Water Shortage Brings Increase of $1,750,000 in Fuel Cost

THE Southern California Edison Company, Los Angeles, Cal., has filed an application with the California Railroad Commission asking a complete readjustment of its rates in the counties of Los Angeles, San Bernardino, Orange, Riverside, Ventura, Kern, Tulare and Fresno, claiming that its present charges, including a surcharge allowed by the commission in December, 1918, do not, because of greatly increased operating expenses, yield a fair return on the company's investment of approximately $84,873,000.

In its application, as a still further reason for a rate increase the company says that the scarcity of water will greatly increase its outlay for fuel oil. In 1920 the estimated expenditure for fuel oil will be $1,750,000 in excess of the expenditure in 1919. This increase in steam generation is due to the present shortage of water combined with the natural growth of the load. The company asks a temporary increase in rates pending a final settlement.

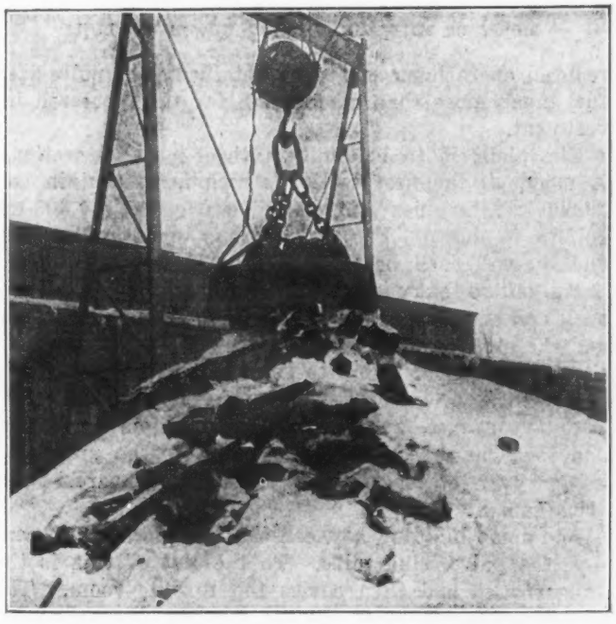
Higher Salaries for Patent Office Employees

A BILL authorizing substantial increases in the salaries paid to the employees of the Patent Office was passed by the House of Representatives March 5. The original draft of the bill was prepared by the National Research Council. It was shown conclusively that the salaries being paid in the Patent Office, especially in the positions where technical knowledge is a requisite, are so inadequate that most of the experienced employees of the bureau already have entered private employment and that there are no applications for the Civil Service examinations for these positions.

Linked with this legislation during the hearings was the proposal for the Patent Court of Appeals. The committee decided, however, that no practical proposition had been set forth showing how this court should be constituted. Consequently the measure will not be presented at this time.

The bill, as it passed the House, authorizes a salary of $6,000 a year for the commissioner of patents, $5,500 for the first assistant, $5,000 for the second assistant and $5,000 for each of five examiners-in-chief. In addition, there are increases for law examiners, examiners of trademarks, assistant examiners, translators, draftsmen and clerks. This allows an increase of $1,000 a year to the commissioner of patents, $1,000 to the first assistant, $1,500 to the second assistant and $1,500 to the examiners-in-chief.

Snow and Ice No Handicap to Electromagnet



AN ELECTROMAGNET *breaking out pig iron from snow and ice, pick and shovel work being dispensed with and weather conditions ignored, is shown here in operation at the factory of the Chapman Valve Manufacturing Company, Indian Orchard, Mass. The magnet shown is a 2,000 lb. Cutler-Hammer 43-in. electromagnet consuming 40 amp. at 220 volts direct current. Two hundred carloads of pig iron are unloaded in a year at this plant.*

Would Serve Power Company in Time of Shortage

IN COMPLIANCE with the order issued on Feb. 26 by the California Railroad Commission, the Sespe Light & Power Company filed a description of its plan for financing the construction of its power plant and irrigation system on the Sespe and Piru Rivers in Ventura County. The company proposes to issue $3,000,000 of first mortgage bonds and $1,000,000 capital stock for the construction of four dams, three water conduits and three power plants, which will constitute the first unit of the company's development. The estimated cost of the above work will total $4,023,000. The company plans to have no distributing system of its own, but is negotiating to wholesale power to the Southern California Edison Company when it would otherwise be consuming fuel oil or stored water. In addition to the power sales, the Sespe company plans to wholesale water for irrigation purposes.

Central Station Soft-Coal Consumption 35,000,000 Tons in 1918

ELECTRIC light and power utilities used 31,693,000 tons of bituminous coal in 1917, with an estimated consumption of 35,000,000 tons in 1918, according to the report of the distribution division of the United States Fuel Administration for 1918-1919, just made public. The 1918 estimate was based on reports from utility companies.

The total production of bituminous coal in 1917 was 551,194,000 tons, and in 1918 it was 579,386,000 tons. Thus 5.75 per cent of production in 1917 and 6.04 per cent of production in 1918 went to electric light and power plants.

In 1917 electric light and power stood fifth in the scale of consumption, greater consumption being registered under the headings "industrials," "railroads," "domestic," "beehive" and "coke." In 1918 electric companies stood sixth, by-product coke taking the fifth place in the table of consumption.

Cost of Running Utility Publicity Bureaus

COMMITTEES similar to the Illinois Committee on Public Utility Information have been created in Indiana, Kentucky, Michigan and Minnesota, and a number of other states are considering similar action. One of these states is Iowa, where a meeting was held recently to consider the formation of such a body. John F. Gilchrist, vice-president of the Commonwealth Edison Company and chairman of the Illinois Committee on Public Utility Information, was the principal speaker at this meeting. The discussion brought out that in Illinois the committee started with a fund of $4,000 accrued on the basis of a levy of 0.005 per cent of the gross earnings of the larger companies. Since that time three similar levies have been made. It is estimated now that the expense of maintaining such a bureau of information in Illinois will be approximately $15,000 a year. The work in Indiana was started on a levy of 0.01 per cent of the gross earnings of the utilities in the beginning.

The organization committee which will handle the

work of getting the Iowa Committee of Public Utility Information under way has been appointed as follows: Representing the Bell Telephone interests, C. A. O'Rourke, Iowa Telephone Company; representing the independent telephone interests, C. C. Deering, Independent Telephone Company; representing the gas interests, A. L. English, Citizens' Gas & Electric Company; representing the street-railway interests, H. E. Weeks, United Light & Railway Company; representing the electric interests, M. G. Linn, Des Moines Electric Company.

Geological Survey's Power Figures for October

THE figures of electric power production for February, March, April and July issued by the Geological Survey last month and printed in the ELECTRICAL WORLD were based on returns received from about 3,000 power plants engaged in public service, including central stations, electric railways and certain other plants which contributed to the public supply. The returns for October do not include the output of plants of less than 100-kw. capacity. The output for October should therefore be increased 0.17 per cent to make it strictly comparable with the figures for the other months, making the October total 3,440,800,000 kw.-hr. All monthly reports represent returns received from plants whose aggregate generating capacity is about 90 per cent of the total of the country.

The average daily output in kilowatt-hours is as follows: February, 106,437,000; March, 101,511,000; April, 100,770,000; July, 101,275,000; October, 110,993,000, using adjusted output for October.

The percentages of total output produced by water power are as follows: February, 38; March, 41; April, 43; July, 39; October, 35. The decrease in the percentage produced by water power is, of course, due to the seasonal decrease in stream flow.

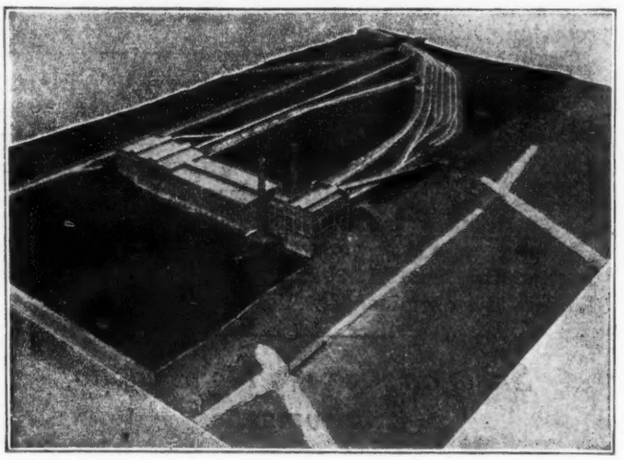
Reports for the other months of 1919, A. H. Horton, of the division of power resources, who compiled these figures states, will not be published. Beginning with January, 1920, it is planned to make reports for each month and to publish them at as nearly current a date as possible. With the January, 1920, report there will be given a summary for 1919, based on the five monthly reports for 1919 and January, 1920.

PRODUCTION OF ELECTRIC ENERGY BY PUBLIC UTILITY POWER PLANTS IN OCTOBER CLASSIFIED ACCORDING TO PRIMARY POWER

State	Thousands of Kilowatt-Hours Produced By Water Power	By Fuel	State	Thousands of Kilowatt-Hours Produced By Water Power	By Fuel
Alabama	15,899	15,102	Nebraska	1,466	19,284
Arizona	8,608	21,782	Nevada	2,896	481
Arkansas	88	8,049	New Hampshire	5,112	3,554
California	157,004	119,486	New Jersey	146	88,207
Colorado	14,861	17,466	New Mexico	110	1,531
Connecticut	10,349	54,827	New York	237,767	313,516
Delaware		6,069	North Carolina	50,475	9,823
District of Columbia		20,543	North Dakota		2,568
Florida	961	9,040	Ohio	2,597	222,585
Georgia	32,626	13,959	Oklahoma	208	14,898
Idaho	40,127	1,270	Oregon	26,285	14,168
Illinois	16,622	222,331	Pennsylvania	42,775	273,804
Indiana	3,442	62,594	Rhode Island	343	24,177
Iowa	57,825	30,626	South Carolina	41,958	4,947
Kansas	807	41,751	South Dakota	828	2,847
Kentucky		18,205	Tennessee	27,203	15,326
Louisiana		17,353	Texas	71	53,499
Maine	20,019	547	Utah	17,344	2
Maryland	68	29,222	Vermont	14,621	165
Massachusetts	33,231	106,363	Virginia	15,708	28,976
Michigan	55,904	134,770	Washington	84,623	11,108
Minnesota	36,580	28,155	West Virginia	1,081	82,507
Mississippi		5,573	Wisconsin	44,401	38,280
Missouri	3,189	44,800	Wyoming	179	957
Montana	68,078	770			
			Total	1,194,485	2,240,560

A Bungalow Type of Power Plant

PULVERIZED coal is to be burned in the Milwaukee (Wis.) Electric Railway and Light Company's 200,000-kw. "Lakeside" power plant, for which ground was recently broken. The elimination of coal-handling machinery and bunkers over the boilers has so reduced the height of the building that it is referred to as a bungalow type of construction. The pulverized-coal installation will cost considerably more than stokers. However, John Anderson, chief engineer of the company's power plant, has shown by a trial installation in the Oneida Street plant (reported in the ELECTRICAL WORLD for Feb. 28) that the increased efficiency and reduced operating costs to be obtained with pulverized fuel much more than compensate for the increased investment.



MODEL OF MILWAUKEE PLANT NOW BEING BUILT

The plant is to be built in three parallel sections. A model of the first section, which is to contain two 20,000-kw. turbines and eight (two spares) 1,306-hp. boilers, is shown. The two sections to be built subsequently will each be rated at 80,000 kw. The plant is laid out so that every section and each unit of all sections can be operated independently from both the steam and the electric side.

A revolving-car dump to the right of the plant will empty the coal out of the cars into hoppers. The coal is to be conveyed from the hoppers to adjacent crushers and then carried on an inclined belt to the green-coal bunker over the coal dryer in the building nearest Lake Michigan.

The small building between the two stacks is to contain the pulverizing mills. To the left of this is the boiler room, and then comes the turbine room. The switchboards will be at the end farthest from the lake, and the step-up transformers for transmission purposes will be in an outdoor substation across the road shown at the back of the plant.

The plans show two railroad tracks leading into the plant, one for coal and freight and the other for passangers. The two service tracks shown in the photo are for taking in and removing machinery. One track goes between the boiler room and the pulverizing room, and the other one leads into the turbine room.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

A New General Electric Company House Organ.—The employees of the Philadelphia works of the General Electric Company have begun the publication of *Switchboard Department News.*

Municipal Plant Seeks Aid.—Owing to increased demand and insufficient equipment, the city of Brigham, Utah, is negotiating with the Utah Light & Power Company for part or all of the electrical energy needed to supply its customers.

An Electrical Show for St. Louis.—As a preliminary to having a real electrical show in St. Louis next year, the St. Louis Electrical Board of Trade took for display purposes one-third of the available space at the Mississippi Valley Exposition held in the St. Louis Coliseum on March 1 to 13 inclusive.

Electricity in Ice Harvesting.—The recent application of electrically driven machinery to harvesting ice in the neighborhood of Sandusky, Ohio, made it possible to triple the amount stored as compared with former methods and also to effect a saving of 75 per cent in cost of labor. About 300 hp. has been used in the work, and a total of more than 250,000 tons of ice had been stored up to the middle of February.

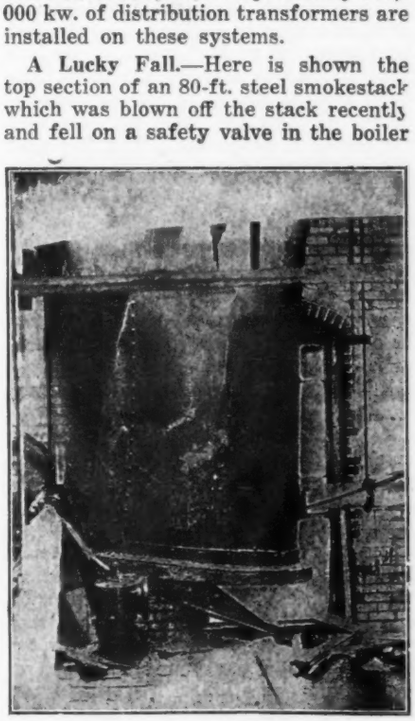
Traveling Fellowships for Scandinavian Colleges.—Twenty fellowships, with a stipend of $1,000 and in some cases $1,200 each, have been established by the American-Scandinavian Foundation, 25 West Forty-fifth Street, New York City, for award to men or women students born in the United States or Canada who desire to pursue technological research and humanistic study in the universities of Sweden, Denmark and Norway. Ten of the fellowships will be for study in the first-named country and five each in the other two. Hydro-electricity is one of the subjects for students sent to Norway and Sweden. Applications must be filed before April 1.

Features of Penn Central Company's System Explained to Bankers.—In order adequately to present the details of the physical properties of the Penn Central Light & Power Company to Philadelphia bankers interested in the sale of a new issue of preference stock of the company, J. G. Zimmermann, its secretary and treasurer, who is also a member of the firm of Day & Zimmermann of Philadelphia, has prepared a series of lantern slides with views of various parts of the transmission lines, substations, railways and power stations. This method of presentation makes it possible to explain the condition of the system and the growth which the company is expected to make. From the standpoint of interesting bankers in the sale of stock issues it has been found very effective.

A New Source of Rubber Supply.—Through the researches of the botanical department of the University of California a source of rubber supply has been discovered and opened up which, it is stated, could already yield three hundred million pounds for use in a national emergency. The desert plant from which this product is obtained is indigenous to the United States and flourishes in soil not adaptable to any other type of vegetation. Should its cultivation on a large scale be undertaken, the important part that electricity would be called on to play is obvious.

California Electric Utilities.—There are eighty-four electric utilities in the State of California, operating seventy-five hydro-electric plants with an installed capacity of 465,000 kw. and fifty steam plants with an installed capacity of 305,000 kw., making a total of 125 plants, aggregating 770,000 kw. During the year 1918 these plants generated a total of 2,892,000,000 kw.-hr., of which 2,163,000,000 kw.-hr., or 75 per cent of the total, was produced from water power. The power is transmitted through 7,300 miles of high-tension transmission lines to points of distribution from which 84,000 miles of secondary distribution lines extend. The installed capacity of consumers' lamps, motors and other power-consuming devices exceeds 1,800,000 hp. Nearly 900,000 kw. of distribution transformers are installed on these systems.

A Lucky Fall.—Here is shown the top section of an 80-ft. steel smokestack which was blown off the stack recently and fell on a safety valve in the boiler



plant of the Springfield (Mo.) Railway & Light Company. The roof of the boiler room broke the fall so that neither the safety valve nor the boiler was injured. This part of the smokestack was known to be almost worn out, and the company had decided to have it removed at a cost of about $500 The wind did the job for nothing.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Philadelphia Section.—The Philadelphia Section of the A. I. E. E. will meet jointly with the Franklin Institute on Wednesday, March 17. G. H. Clamer will present a paper on "Induction Electrical Furnaces."

Joint Philadelphia and Washington Meeting.—The Philadelphia Section of the Illuminating Engineering Society is to meet at the Cosmos Club, Washington, D. C., on Friday, March 19, when, under the auspices of the Washington Section, A. I. E. E., two illustrated papers will be presented—one by Ward Harrison on "Development of the R. L. M. Standards for Industrial Lighting," and the other by M. Luckiesh on "Residence Lighting."

New England Question-Box Conference.—The last call is now going out for the question-box conference of the New England Section of the National Electric Light Association, to be held at the American House, Boston, on March 18. A forenoon session will be devoted to commercial relations, lighting, merchandising, power, ranges and water heating, and in the afternoon the principal subjects will be accounting, advertising and the electric vehicle.

Electrical Contractors' Association of Connecticut.—W. L. Goodwin and Samuel M. Chase addressed this association at New Haven on March 2 upon trade relations. About 100 members and guests were present. The policy of cut-price sales by central stations was vigorously attacked and the importance of co-operation on the part of all interests in the industry emphasized. James E. Wilson, secretary of the Massachusetts branch of the National Association of Electrical Contractor-Dealers, told of the progress that has been made by the organization in northern and central New England.

Chicago Section, A. I. E. E.—The coal saving which railroad electrification in the United States can effect was discussed by S. T. Dodd, engineer of electrification, General Electric Company, Schenectady, N. Y., before this section and other Chicago engineering societies on March 4. Mr. Dodd showed that a locomotive requires the equivalent of 7.56 lb. of coal per kilowatt-hour to drive it, while the efficient central station requires about one-fourth of this amount. The speaker also showed the enormous quantities of coal consumed by the railroads in hauling the coal they use. The paper followed the same general lines as one by A. H. Armstrong, read before the Schenectady Section of the American Institute of Electrical Engineers on Feb. 20.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Commission Not Vested with Arbitrary Powers.—That the Public Utilities Commission of Illinois has no arbitrary powers and that its orders and decisions are subject to review and must be reasonable and lawful is the judgment of the Supreme Court of that state in a proceeding arising from the commission's refusal to issue a certificate of convenience and necessity to a bus line. (125 N. E. 373.)

Charging for Arrearages.—The Supreme Court of Mississippi held, in Meridian Light & Railway Company vs. Steele, that a contract with an electric light company for service in so far as it binds the customer to pay arrearages on account of a former residence before the installation of service in a new residence is void and that the company delaying service for such reason is liable for damages. (83 S. 414.)

Injury to Gossiping Workmen Not Engaged at Task.—By a decision of the Supreme Court of New Hampshire, in a factory where it was customary for temporarily idle employees to go about the room and talk with others it cannot be maintained as a matter of law that it was not the duty of the employer to exercise reasonable care in guarding machines so as to protect such an employee from possible injury. (108 A. 690.)

Determining Degree of Workmen's Disability.—The workmen's compensation act of Colorado, according to the Supreme Court of that state, vests the widest discretion in the Industrial Commission to determine whether under particular circumstances there should be applied the rule that the degree of disability is to be determined by general impairment of earning capacity without respect to any particular kind of labor or whether it should be determined by impairment of earning capacity in the kind of labor in which claimant was employed when injured. (186 P. 522.)

Application of Workmen's Compensation Act in Case of Accident Outside of State.—The acceptance of the workmen's compensation act of New Jersey is optional and hence contractual; in New York the scheme of compensation is mandatory. However, in the case of an employee of the New Jersey corporation who accepted the law of that State and was accidentally killed in New York, the New York Court of Appeals has decreed that the New Jersey act may be enforced in New York, there being nothing in the public policy of the latter state to the contrary. (125 N. E. 675.)

Confiscatory Rates.—It has been declared by the New York Supreme Court, in Bronx Gas & Electric Company vs. Public Service Commission, First District, that the returns from a gas company's electrical department cannot be considered on the question whether a statute fixing gas rates is confiscatory. Nor has the court jurisdiction to enjoin the Public Service Commission from interfering with the enforcement of a new rate filed with it in a case where the statute fixing a lower rate has been declared confiscatory as to the rate but effective to prevent the commission from fixing a higher rate, since the granting of the injunction would, in effect, be a determination by the court that the rate sought by the utility was a reasonable one and the court has no power to fix rates. (178 N. Y. S. 218.)

Transmission Company Not Negligent Because of Failure to Label High-Voltage Lines.—In a suit brought against the Pacific Gas & Electric Company to recover damages for the death of a minor employed by a contractor it was brought out that the contractor, desiring to move a pile driver on or near a road alongside which a 2,300-volt electric line was carried on poles, asked the agent of the electric company to move the wires, which the latter agreed to do. The promise not being kept, the contractor moved the pile driver on his own responsibility and accidental contact with the wires killed his employee. The Supreme Court of California held that the electric company was not negligent in failing to provide a sign to indicate that the line was operated at high voltage, for the fact that it was a power line must have been evident and it is common knowledge that any line carrying electricity for power is dangerous. The fact that the insulation on the wire was hanging in strips only made the need for caution more evident. (186 P. 354.)

Penalty for Failure to Supply Electric Power as Agreed.—In Coal District Power Company vs. Katy Coal Company the Supreme Court of Arkansas has ruled that failure of a power company to provide the service contracted for could not be excused by the fact that the war made it impossible to procure certain supplies; that a power company so failing in a case where it was understood that electric power was to be substituted for steam power and steam machinery removed was liable in damages for the net profits that would have been made in the time during which complainant's mine had to be closed; that, however, complainant was not entitled in addition to money for excessive labor and power employed in the partial operation of the mine as all operating costs should have been taken into account in ascertaining the loss of profits, and that the damages allowed cannot be called speculative or conjectural where testimony showed the output of the mine when its operation was not interfered with, the profit per ton, and the time during which there was suspension of operation due to the lack of power. (217 S. W. 440.)

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

By-product Operation—Federal Income Tax.—Two recent *obiter dicta* by the Indiana Public Service Commission are that, under present conditions, the operation of a hot-water-heating plant in connection with an electric plant cannot be considered as a by-product operation, and that the federal income tax is not a proper charge to operation.

Refusal to Increase Rates.—The Missouri Public Service Commission has refused to increase the rates of an electric company, although such rates were producing a return of only 4.64 per cent on the value of the property, where it appeared that the company had lost business and therefore revenue because of its failure to keep its generating plant in a good operating condition and it further appeared that the average earnings of the electric department during the last five-year period would still exceed a reasonable return.

Obviating Estimates of Transformer Losses.—In determining a schedule of electric rates the Wisconsin Railroad Commission endeavored to design one which would not only produce the required revenues but result in an economic use of the energy by consumers, and rather than include provisions which would necessitate estimates of transformer losses on rural and power consumers, the commission, in the case of rural consumers, provided for a differential in the rate, and, in the case of power consumers, recommended the installation of disconnecting switches for the large users which would permit cutting the transformers off when not in use.

Principles of Valuation.—In an application for authority to increase rates, made by the Elkhart Lake Light & Power Company, the Wisconsin Railroad Commission declared that (1) some allowance should be made for an investment in a hydro-electric development in determining the reasonableness of the rates of an electric utility, although the electric company purchases its energy from another company, where it appears that the hydro-electric plant has some real value in voltage regulation; (2) discarded equipment should be deducted from the book value of a plant, and, upon disposition, any loss that the company may have suffered as between the original cost and the junk sale price, plus the depreciation set up for it, assuming that a reasonable provision has been made for such depreciation, should be amortized over a period of years and the equivalent amounts charged to operating expenses.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

R. S. Bell of the Northern Ohio Traction & Light Company, Akron, Ohio, has been transferred to Jackson, Mich., and is now doing industrial power work for Hodenpyl, Hardy & Company.

J. F. Mayo, formerly illuminating engineer for the Consumers' Power Company, Jackson, Mich., has been made sales superintendent of the Jackson district for the same company.

O. B. Coldwell of Portland, Ore., who has recently been appointed second vice-president of the Portland Railway, Light & Power Company, has for a number of years been prominently identified with the light and power industry in the Northwest. During all of this period he has served as chairman of the executive committee of the Northwest Electric Light & Power Association, and he was also one of the early presidents of that association. He received his technical education at Leland Stanford Junior University with the class of 1902 and later at Cornell University. Upon returning to the West he entered the employ of the

O. B. COLDWELL

Portland Railway, Light & Power Company on its engineering staff, rapidly rising to the position of chief engineer. For several years he has been general superintendent of the Portland Railway, Light & Power Company. Mr. Coldwell is chairman of a special committee which, with the indorsement of the Northwest Electric Light & Power Association, is planning to run a special train from that section to the Pasadena convention of the National Electric Light Association next May.

Thomas W. Martin, vice-president and general counsel of the Alabama Power Company, Birmingham, Ala., has been elected president of that company, succeeding James Mitchell, who has resigned to become chairman of the board of directors on account of ill health.

James Mitchell, who was one of the organizers of the Alabama Power Company and has held the position of president since its formation in 1912, has resigned and been elected chairman of the board of directors of the company. This change in duties had been requested by Mr. Mitchell on account of ill health.

Walter N. Walmsley, general manager of the Alabama Power Company, Birmingham, Ala., has been elected vice-president of that company.

Rudolph Schmutz has been appointed chief engineer at the Drumright plant of the Oklahoma Gas & Electric Company, succeeding F. C. Bray.

Townsend H. Soren, vice-president of the Hartford (Conn.) Electric Light Company, has been elected president of the Hartford Home Building Association, Inc.

W. L. Mason, heretofore vice-president of the Keene (N. H.) Gas & Electric Company, was elected president of that company and the Ashuelot Gas & Electric Company.

Edward S. Clinch, Jr., consulting engineer, has opened offices at 116 West Thirty-ninth Street, New York, for handling all matters connected with the mechanical equipment of industrial plants, hotels and other buildings.

Robert Howes has reopened his consulting engineering office at 1039 Henry Building, Seattle, Wash. During the war he had charge of work for the United States Housing Corporation at Bremerton, Wash. He also served as technical assistant to the Pacific Coast manager of the United States Housing Corporation at San Francisco.

Col. George E. A. Fairley, Baltimore, Md., for five years assistant chief engineer of the Electrical Commission of the city of Baltimore, who resigned that position to enter government service, has received a promotion to the grade of lieutenant colonel, Reserve Corps of Engineers. Colonel Fairley served fifteen months in France.

Albert Milmow, who for a number of years has been attached to the Charlotte (N. C.) office of the Westinghouse Electric & Manufacturing Company as engineer in charge of special textile work in North and South Carolina, has resigned to become associated with the firm of Michael & Bivens of Gastonia, N. C., which is one of the largest electrical contractors in heavy industrial work in the South. Mr. Milmow has been prominently connected with sales work in the South for the last fourteen years. He opened and organized the sales office of the General Electric Company in Charlotte. Later he was called upon to organize the power sales and mill engineering of the Southern Power Company. Then he was connected with the Alabama Power Company and the Union Gas & Electric Company of Cincinnati, returning to Charlotte to take the position he has just resigned.

Frederick H. Smith, for the past year superintendent of distribution of light and power of the Newburyport (Mass.) Gas & Electric Company, has resigned to become local manager for J. J. Merrill, electrical engineer and constructor. Before his association with the Newburyport company Mr. Smith was for eight years with the Turners Falls Power & Electric Company.

William Rawson Collier, formerly operating and sales manager of the electrical department of the Georgia Railway & Power Company in Atlanta, Ga., was appointed general sales manager of that company on Feb. 1. Mr. Collier's engineering career began with his graduation from the Massachusetts Institute of Technology in 1900, from which institute he entered the consulting engineering field as junior member of the firm of Collier & Brown. In 1902 he joined the engineering staff of the Georgia Railway & Electric Company as assistant engineer and in rapid promotions has served as contract

W. R. COLLIER

agent, sales manager Georgia Railway & Power Company and Atlanta Gas Light Company, and operating and sales manager, electric department, Georgia Railway & Power Company. In his present position as general sales manager of the company he is in charge of all sales of electric light, heat and power, gas and steam heat. In addition, the gas shop, gas storeroom, gas meter department, electric meter department and the management of the Carrollton, Gainesville and Franklin districts served by the company are placed under his direct supervision. During the war Mr. Collier served as local public utility representative of the priorities committee, War Industries Board, and later, during the recent coal strike, as public utilities representative of the regional coal committee. This latter position involved the handling of the fuel supply to all gas, water and electric utilities in the Southeast. As a member of the National Electric Light Association and other similar bodies Mr. Collier is an active participant in all matters looking toward the betterment of the industry, having been prominently identified with most of the constructive work of this nature throughout the Southeast.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Record-Breaking Demand for Motors Continues

THE market for electric motors is fast approaching a point where the manufacturers will be unable to make deliveries before fall unless present handicaps to production can be relieved. Already it is impossible in many cases to secure deliveries this year on fractional-horsepower motors, and it would be little exaggeration to state that the washing-machine or vacuum-cleaner maker who has not already contracted for his 1920 consignments stands small chance of obtaining motors before next January. In the field of general service motor conditions are not quite so serious, but the demand is increasing so fast that manufacturing facilities simply cannot keep pace with it, and even the most strenuous efforts to enlarge existing factories and establish new ones have thus far only stemmed the tide sufficiently to avoid a literal deluge of unfillable orders.

The demand for motors comes from all sections of the country and from practically all branches of industry. Notwithstanding the situation in foreign exchange, an overseas call for American-made motors is springing up. This is adding greatly to the pressure already exerted by the domestic demand. Up to March 1 the demand for motors upon representative factories exceeded that of the same period last year by 25 per cent. Bids for 1921 delivery were wanted on $250,000 worth of motors by one concern which entered the market a few days since—a striking instance of the confidence felt by manufacturers, in some fields at least, as to the continuance of active business for some time.

Relation of Credit to Unequal Price Level

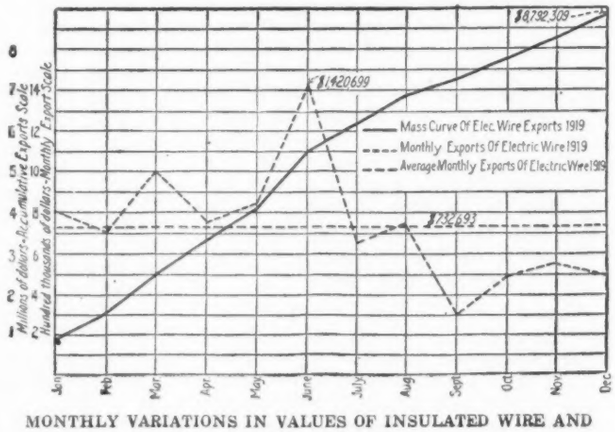
MOTOR buyers are finding that, contrary to all precedent, prices asked by smaller manufacturers are higher than those asked by the larger concerns. By the time these words are printed it seems likely that a similar situation will prevail in the electric controller field. It is true, of course, that the smaller companies are making much quicker deliveries than the larger ones, and it is this item of delivery which helps them to make sales under their terms. In the old days, when a buyers' market prevailed, it was not usual to find the smaller companies underselling the larger ones. They felt they had to offer some inducement to get business, so they offered an attractive price. Later, as demand more nearly equaled supply, the prices of practically all manufacturers were very close together. All were affected in about the same way by increasing prices of labor and material, and as prices advanced there was until recently little change in the level competitive price situation. Higher costs have continued to beset the manufacturers, and the smaller concerns have gone ahead establishing new prices that will continue to give them their usual margin of profit without waiting to see whether larger competitors intended to do likewise. In taking this step the smaller companies have had their courage fortified by a stack of future delivery orders.

A large factor affecting general business prosperity is credit, and this has been greatly inflated. Deflation appears necessary and in fact has already begun in speculative and investment credit through the increasing discount rate of the Federal Reserve banks with respect to call money. Now, if the aid of the same machinery is invoked to reduce commercial credit inflation, and if the Federal Reserve banks' discount rate for commercial paper is increased, the natural result to expect is large cancellations of existing orders. Perhaps one-half of all orders will be canceled. At such a time the manufacturing concern which has twice as many orders on its books as it can actually fill will, theoretically at least, occupy a very desirable position. The observers who argue in this way point out that the hope of getting twice as many orders as they can fill is the motive which keeps some motor manufacturers from raising prices. These observers also declare a belief that when the period of order canceling comes it will be of short duration because the great basic demand must be filled. When the manufacturers who are raising prices are confronted with this argument they express a belief that it will be just as well for them to meet the cancellation period with a surplus of dollars stored up against that time and taken out of adequate profits today as to sacrifice profit today in order to enter the period of depression with bona fide orders to fill.

It is natural to expect that some concerns will try to work out combinations of the two policies discussed above. Perhaps the most common of these combination methods is the one adopted by a concern which is increasing its prices and its sales effort simultaneously in an endeavor to get both a large immediate profit and an adequate supply of future orders.

Analysis of 1919 Insulated Wire and Cable Exports

ALMOST 10 per cent of the value of electrical exports in 1919 was in insulated wire and cable, last year's exports of these products amounting to $8,792,309. Owing to the changing price of wire it is difficult to make month-by-month comparisons. Nor is it possible to make any very careful studies based on domestic prices. Export prices for wire are affected by a different set of factors. The curve in Fig. 1, however, shows the monthly variation in value of insulated wire and cable exports. The first half of the year, it will be noticed, was well above the average, while the opposite is true of the second half. Advancing

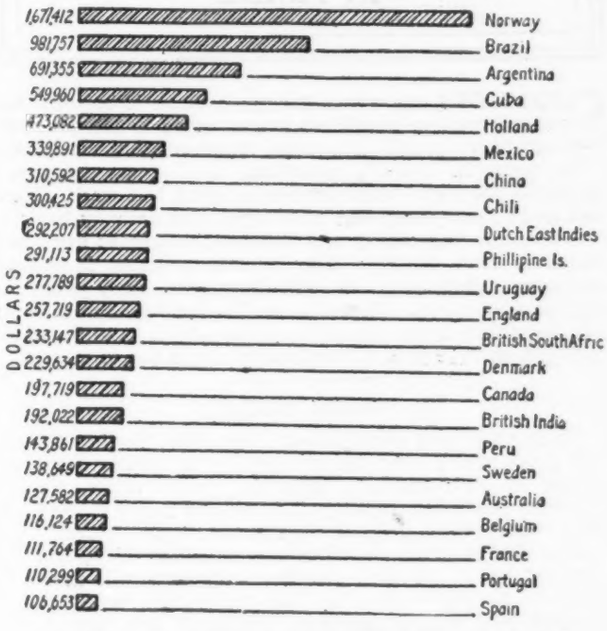


MONTHLY VARIATIONS IN VALUES OF INSULATED WIRE AND CABLE EXPORTS

rates of exchange undoubtedly were a factor the latter part of the year.

Data compiled by the ELECTRICAL WORLD indicate that Norway imported almost twice as much insulated wire and cable from America as did any other country, with a total of $1,671,412. Brazil and Argentina were second and third,

with $981,787 and $691,355 respectively. Fig. 2 indicates the large extent of the South American market for this class of electrical goods. Five of the countries of that continent imported American wire and cable valued at more than $100,000, or a total of $2,395,185. To our neighbors, Canada, Mexico and Cuba, exports of these goods



EXPORTS OF AMERICAN INSULATED WIRE AND CABLE TO FOREIGN COUNTRIES

totaled $1,087,570. Taking into consideration only such countries as imported $100,000 or more of this class of American electrical goods, continental America trade accounted for $3,482,755 worth, or 39 per cent; European imports totaled $3,215,336, or 37 per cent, and the remaining $2,094,211, or 24 per cent, went mostly to China, the Dutch East Indies and British South Africa. Australian orders totaled only $127,582.

The above figures are based on export statistics issued by the Bureau of Domestic and Foreign Commerce for 1919.

Extensive Changes in Control Design Anticipated

LOCAL inspection rules in Chicago and in San Francisco now call for the inclosing of all face-plate types of control equipment. Manufacturers of electrical control equipment who have been viewing this development of the rules believe that the activity of the inspection bureaus of the electrical departments in the two cities named will impose a handicap on controller manufacturers and especially on the smaller ones.

Inclosing face-plate equipment will require a considerable amount of sheet iron in gages which are extremely scarce at the present time. It means that manufacturers of control equipment will have to go into the business of making sheet-metal boxes, will have to put on new drafting crews to design them and will have to enlarge the tool departments for making dies and bending tools. One of the smaller controller manufacturers has stated that his concern will have to make numerous drawings, templets, dies, jigs and special tools to meet the demands of the Chicago market. With his limited line of control equipment it will require nineteen complete sets of dies, jigs, templets and tools, which will cost around $12,000. Some of the control manufacturers contend that it should be sufficient to have the electrical contractors inclose the starters or speed regulators of the face-plate type in sheet-iron boxes with hinged covers which are opened when the machine is being operated.

It is the attitude of the inspection department of Chicago at least that the inclosure must be made by the manufacturer. It is permissible to design the equipment with a handle extending through the slot if the design will eliminate the danger from flying sparks and will inclose all live parts. It is believed that the additional expense which the industry will be put to to meet these demands will be justified by the increased safety gained in installations of this character. This is the point of view on the safety features and elimination of fire hazards which the electrical bureaus are announcing to the manufacturers interested in the production of this equipment.

Canadian Laco Lamps, Ltd., to Take Over Dominion Plant

The Canadian Laco Lamps, Ltd., has just been incorporated under the laws of the Dominion of Canada to operate under a license granted by the Canadian General Electric Company to the Canadian Laco Philips Company to manufacture tungsten lamps under the Coolidge and Langmuir patents.

This new concern, according to a statement made to the *Electrical World*, is arranging to place its stock largely in the hands of Canadian electrical interests and has no connection either direct or indirect with the Philips Glowlamp Works of Holland, as was erroneously intimated in *Electrical World* for Feb. 28.

The new company will take over the plant of the Dominion Lamp Company, Ltd., of Montreal.

Export Trade Continues to Fall Off

DURING January the exports of electrical goods dropped to $6,347,497, which is lower than any month since September last and about 5 per cent lower than during January, 1919.

A new high record of $183,404 was hung up in telegraph apparatus. The exports of insulated wire and cable and of transformers were also better than they had been for some months. On the other hand, the January shipments of metal-filament lamps were very low. Shipments of rheostats, telephones and miscellaneous supplies were lower than usual.

The figures for the month, which follow, were obtained from the Bureau of Foreign and Domestic Commerce:

	1919	1920
Batteries	$345,811	$374,730
Carbons	189,351	139,640
Dynamos and generators	249,853	413,293
Fans	176,526	29,587
Heating and cooking apparatus	98,515	113,819
Insulated wire and cable	804,481	661,842
Interior wiring supplies	194,565	168,889
Arc lamps	206	90
Carbon-filament lamps	20,034	7,133
Metal-filament lamps	578,175	211,697
Magnetos, spark plugs, etc	279,174	261,542
Meters and measuring instruments	324,404	188,133
Motors	680,882	733,822
Rheostats and controllers	48,436	18,558
Switches and accessories	177,159	294,036
Telegraph apparatus	56,541	183,404
Telephones	214,172	230,186
Transformers	309,028	350,364
All others	1,975,211	1,966,672
Total	$6,722,524	$6,347,477

Mexican Heating Appliances on Display

THE Associated Manufacturers of Electrical Supplies has added to its collection of foreign-made electrical products a number of electric heating and cookery appliances made in Mexico. The open-resistance coil is used in each case and is held in grooves in a native baked clay. The samples, seven in all, were presented to the association by the Westinghouse Electric International Company.

The samples and list prices follow: Round stove, $2.50; one-burner square stove, $3; two-burner square stove, $6; electric oven, $11.50; large water heater, $2.50; small water

heater, 75 cents; one-burner square heater with cover, $3. Discounts are allowed from these prices of from 10 to 25 per cent, depending upon the quantity.

Glassware Shortage Directs Residential Fixture Design to Candelabra Type

AMONG the fixtures for residential use the candelabra type can be said easily to predominate for 1920. Perhaps eight out of ten fixtures shown at the Detroit fixture market were candle fixtures of some design equipped with bare, round frosted lamps, generally of the 25-watt size. Credit for the origin of this style of fixture, which is heartily detested by illuminating engineers, is said to lie with the glass manufacturer, who has forced it through his inability to deliver illuminating glassware to the fixture manufacturer. It is said that, even with this style established and with the demand for glass thus reduced, glassware is still the neck of the bottle in the production of fixtures requiring it. It appears, however, that in the days ahead, shortages in steel sheets will claim more attention than shortages in glass. Even now it is almost as cheap to build a fixture of brass as of steel.

Besides the candelabra idea, one other residential fixture tendency is apparent. That is the movement to make fixtures in such a way that their entire appearance may be changed by the housewife easily and at reasonable expense. Along with this plan appears the attempt to combine with these fixtures fundamental ideas of good lighting that will not be eradicated by whatever changes are made in the fixtures. Evidence that the tendency is growing rapidly toward this type of fixture is at once apparent when the observer remembers that it has been only a few months since the first design appeared and already several other designs are on the market, while still others are about ready to be announced.

Metal Market Situation

METALS generally showed a falling off in price during last week. Copper dropped another quarter of a cent. Antimony and zinc also eased off slightly. Tin is still in a fast downward plunge. On Monday Straits was quoted at 61.50, a drop of 3 cents during the week. Lead stiffened slightly. Old coppers and brasses followed the downward trend of the new metals.

Copper futures are being held for better prices. Second quarter copper is quoted at 18¾ to 18½, third quarter, 18¾ to 19 and fourth quarter, 19¼ to 19½. Little of the present business is being done with producers who are holding ou. for 18¾. Buyers generally seem indisposed to place large buying orders while holders of stock are reported to be releasing them.

Demand for copper sheets is reported to be large but a very small call for copper and brass tubes is noted. Copper sheets were quoted at 29½ on Tuesday, rods at 26¾ and seamless tubes at 32.

NEW YORK METAL MARKET PRICES

	March 2	March 8
Copper	£ s d	£ s d
London, standard spot	119 7 6	121 0 0
	Cents per Pound	Cents per Pound
Prime Lake	19.00	18.75
Electrolytic	18.50	18.25
Casting	18.37½	18.00
Wire base	22.25	22.25
Lead, trust price	9.00	9.25
Antimony	11.62½	11.37½
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Spelter, spot	9.10	8.85
Tin	63.50	61.50
Aluminum, 98 to 99 per cent	31.00 to 32.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17.00 to 17.50	16.50 to 17.00
Brass, heavy	9.50 to 10.25	9.50 to 10.00
Brass, light	9.00 to 9.25	8.75 to 9.00
Lead, heavy	7.50 to 7.75	7.75 to 8.00
Zinc, old cr p	5.00 to 5.25	5.00 to 5.25

THE WEEK
IN TRADE

SHORTAGES are worse, but the outlook is better. Improved weather conditions are expected to release more materials through improved transportation conditions.

Increases in conduit, porcelain, small motors, storage batteries, poles and hardware are reported this week. More and more items are going on the price at delivery basis.

Demand is very heavy and increased purchases are being urged in some centers. The building program is getting under way, but there are indications that many proposals will be withdrawn. Expressions of a feeling of uneasiness are becoming more numerous. The abandon with which high prices were paid a few months ago is not so evident.

NEW YORK

During the past week jobbers have been playing a waiting game which consisted principally in waiting for shipments of rigid conduit, porcelain, outlet boxes, flexible armored conductor, lighting fixtures and many other products, which were delayed by the recent snowstorm. Demands for building materials are mounting high, and the jobbers' hopes are that quantity shipments will arrive in time to prevent delays or hold-ups in the work. Rigid conduit and flexible armored conductor are particularly scarce. Manufacturers have issued rigid-conduit card No. 44 which contains several changes.

Shipments which have been side-tracked or stalled in the snow are again reported moving, and it is the popular belief that by next week a considerable number of carloads of material will have arrived.

In the absence of much material, which is badly needed, jobbers have busied themselves by booking large orders of washing machines, vacuum cleaners, lighting fixtures, brassware and sockets.

Price advances are announced on porcelains and on the Thor No. 12 vacuum cleaners.

Rigid Conduit.—Demand for rigid conduit has brought about a serious shortage, especially in the larger sizes. Manufacturers have issued a new card No. 44. No advance is made on carload lots, but for 10,000 lb. and less the increase will amount to approximately 5 per cent. Where formerly four points were charged for warehousing in New York City the new card charges six points.

Porcelain.—Building plans call for more porcelain than jobbers can obtain. They are meeting present demands fairly well, although a shortage is in sight. Effective Monday, the list price was increased approximately 100 per cent, the discounts of 60 per cent on tubes and 65 per cent on knobs and cleats remaining unchanged.

Flexible Armored Conductor.—Two-wire conductor is scarce. Few jobbers report enough for a medium-sized order. Shipments are expected which will help considerably, although it is known the shortage may last for some time.

Vacuum Cleaners.—Orders continue to pile up with but slight chances of being filled in the near future. On Monday a price advance of from $35 to $42.50 was made on Thor No. 12 vacuum cleaner. The attachments were increased from $8 to $9.50.

Lamp Cord.—Stocks are almost all depleted. Several jobbers report less than 500 ft. on hand. Supplies are expected daily.

Washing Machines.—Demand is constantly increasing and jobbers can sell all available machines. One firm which has a number of carloads en route has ordered three additional car loads to clear up present orders.

Heating Appliances.—Jobbers' shelves are virtually bare with manufacturers' deliveries growing longer, six to eight

months being quoted by two manufacturers. Delayed shipments will help the situation considerably.

Lighting Fixtures.—Good volume of sales in lighting fixtures is reported from New Jersey districts and the outlying suburbs. Jobbers report heavy demand for next two months.

CHICAGO

Sales in continued heavy volume are reported by both jobbers and retailers, with the prevailing condition of no fixed prices in many lines seeming to have no effect on the flow of business. The volume of retail sales in appliances and the prospect of its continuance are indicated by the growth of the Commonwealth Edison Company's electric shop here. This concern has leased 9,000 sq. ft. of retail sales space and 6,000 sq.ft. of storage space in an adjoining building.

Delivery conditions remain very bad. Some jobbers report a volume of material on back orders, in certain lines equivalent to a whole normal year's business. This is true of loom and various styles of lamp cord. Orders for all kinds of conduit, armored conductors, outlet boxes and covers, molding fittings, standard porcelain, certain lines of heating devices and ironing machines are accepted by jobbers only at the price prevailing at time of shipment, delivery at manufacturers' convenience.

The Illinois Central Railroad is perfecting a separate organization to handle the job of electrifying its terminals in Chicago under the direction of Vice-president A. S. Baldwin.

Certain jobbers are advising architects and engineers to place orders now for any conduit they feel certain they will need during the course of the next eight months, even though plans for the buildings in question are not yet completed. This advice is being followed in many instances and has resulted in a further accumulation of back orders for this class of material. In like manner dealers are being urged to order stocks regardless of price or delivery date.

Building permits in Chicago last week totaled $2,250,000.

Wire.—While no changes have occurred in quoted prices, delivery conditions have become steadily worse. The best promise that can be secured on small quantities of weatherproof is four to five months, with some manufacturers refusing to book any additional business.

Loom.—Quotations have been withdrawn, orders being placed for delivery at manufacturer's convenience.

Rigid Conduit.—A slight let-up in demand for immediate delivery has temporarily eased up stock shortage. Delivery of orders booked for future shipment will render this condition of short duration.

Lamp Cord.—Without exception, all styles of lamp cord are completely out of stock. Jobbers complain that manufacturers' prices show a range of as much as 30 per cent on similar grades.

Motors.—A readjustment of prices, with increases ranging from 5 to 10 per cent, is looked for at an early date, although nothing has yet been officially announced.

Poles.—Demand greatly exceeds supply. New prices were issued this week. Poles 30 ft. and 6 in. are now $8.30 and 35-ft., 6-in. poles are $11.05, against former prices of $6.80 and $9.05 respectively. Seven-inch poles are quoted at $11.05 for 30-ft. and $14.90 for 35-ft., comparing with previous quotation of $9.05 and $12.40.

Batteries.—Fair stocks insure deliveries at least for some time. An advance of approximately 15 per cent is noted on "Hot Shot."

Electric Locomotives.—Unprecedented demand is noted for electric locomotives to run on rails for use in industrial plants. Orders are for equipment ranging in size from 2 tons to 50 tons, with the 10-ton size predominating.

Hydraulic Governors.—Volume of orders is causing one manufacturer to increase his space 50 per cent. He states that even this enlarged capacity will be insufficient to handle the business in sight.

BOSTON

Orders are coming in again in full tide, but deliveries are very uncertain on account of continued severe weather. Northern New England was practically overwhelmed by the blizzard of last week, with a complete tie-up of transportation. Collections are holding up fairly well in central and southern New England. Jobbers' stocks are extremely spotty, and occasional arrivals of carload shipments of fast-moving supplies are almost immediately absorbed. Prices still tend upward, with advances in small motors and alkaline storage batteries and stiffer quotations on armored flexible conductor. Building contracts to March 4 total $44,406,000, compared with $12,940,000 for the same period in 1919. The Salem Electric Lighting Company will add a 7,500-kw. turbine unit and boiler to its plant.

Motors.—A price increase amounting to between 5 and 10 per cent on the average was announced Monday on motors manufactured at Lynn, Mass., by the General Electric Company. This covers small motors (not fractional horsepowers) up to about 30 hp. in both direct-current and alternating-current designs. The demand for motors of all standard makes is record-breaking, and below 50 hp., few immediate shipments can be made by either manufacturers or dealers.

Lamps.—A surplus no longer exists, even with the larger distributers. Local stocks are somewhat spotty, with the most acute shortages in 25, 40 and 50-watt clear tungstens. Shipments are being sharply controlled.

Storage Batteries.—Edison batteries are up 10 per cent in price. Orders are coming in very rapidly, and local stocks in some makes are sold into early summer.

Electric Ranges.—The demand exceeds manufacturing abilities. Factory stocks are bare. A 10 per cent advance on Simplex ranges was recently announced. Manufacturers are operating regularly, but are anxious about supply shipments and outgoing transportation conditions.

Wire.—A few deliveries are being made by water shipments, but railroad movement of wire is at a low ebb. The demand is brisk for all ordinary grades and sizes. Rubber-covered, No. 14, is quoted at $11.50 per 1,000 ft. in lots of 5,000 ft. and over; $13 in coil to 5,000 ft. and $16 per 1,000 ft. on less-than-coil lots. Weatherproof wire, triple-braid, No. 10, is quoted at 27 cents per pound, and the bare base is around 25 cents on No. 4/0 to No. 8.

Armored Flexible Conductor.—Prices are firm, No. 14 single-strip being quoted at $100 per 1,000 ft. in coil lots and $105 in less. Stocks are very low, and one jobber received 10,000 ft. Monday only to have it vanish before night.

Non-Metallic Flexible Conduit.—Prices are steady, with slim stocks. The 7/32-in. size brings $37 per 1,000 ft. and the ½-in. size $40.

Sockets.—Prices are shifty, although fair stocks are in hand. Pulls in standard packages brought 47.5 cents net, keys 28 cents and keyless 26 cents the first of the week. The present demand, while large, is being well met.

Fixtures.—Some excellent stocks of residential lighting fixtures can be located here, but industrial equipment is harder to obtain. There seems little probability of overstocking the industrial market this year.

Fans.—Early shipments have not materialized as yet. The outlook for obtaining additional shipments above orders previously placed for this year is at present dim.

Appliances.—The demand for washers and cleaners continues heavy. Irons are being ordered for fall delivery. One of the large New England wringer factories has been forced to shut down temporarily for lack of raw material.

Rigid Conduit and Porcelain.—Stocks are appallingly low, with no relief in sight.

ATLANTA

Business conditions continue very active, and all jobbing firms are complaining of inability to get large enough shipments. Building activities slowed up somewhat because of inclement weather and then took a fresh start. Reports indicate that no slackening in the orders has been

felt despite the sharp advance in prices of a number of lines, notably poles, pole-line hardware, lamp cord and fans. There is an increasing number of articles on which prices have been withdrawn and which are being sold only on the basis of price at the date of shipment.

Jobbers report that business for the month of February, 1920, exceeded the business done in the same month of the preceding year by from 50 to 100 per cent, while sales to date seem to indicate that March will do even better. Contrary to predictions of some, there are not enough cancellations of back orders being received to be worthy of mention. Collections are reported good throughout the section.

Wire.—Stocks of wire are not so good as last week, particularly in the popular sizes of Nos. 6, 8 and 10. Despite fair shipments, the demand for these sizes prevents the accumulation of any stocks of moment. Wire prices remain steady with rubber-covered at 28 cents and weatherproof at 29 cents base.

Condulets.—One jobber reports the receipt of a very large shipment of condulets which were promptly absorbed by back orders and current demand.

Poles.—A price advance of 10 per cent is announced on white cedar poles. Stocks in the territory are reported fair, but car shortage makes delivery difficult. Price on 30-ft., 6-in. tops, is $9.40.

Pole-Line Hardware.—Owing to the construction of new distributing systems and the expansion of present systems, the trade reports a brisk movement of hardware. Prices have advanced from 10 to 15 per cent in the past week. Stocks and shipments are reported fair.

Motors.—Industrial plants changing over from mechanical to electric drive keep motor stocks in a very spotty condition. It is almost impossible to obtain a prompt delivery on any of the popular sizes, shipments averaging from twelve to eighteen weeks. One of the largest manufacturers announces a 10 per cent increase, effective March 1.

Fans.—The few warm days just past have ushered in the first of the fan season, and jobbers report their stocks beginning to move. As heretofore mentioned, local stocks will be in good shape by the time the season is in full swing, and dealers are anticipating a record fan season in the face of a 12 per cent price advance.

Glassware.—No material stocks are in the territory, and best shipments promised are approximately five months. As a result jobbers who succeed in accumulating a fair stock of this article will obtain a high price for their holdings. All sales are being made on the basis of price at date of shipment.

Fixtures.—Contrary to the usual form, this being the off season, the demand for fixtures is holding up remarkably well. Jobbers report that a big business is being done, particularly in the smaller rural communities, while prospects for the summer and fall indicate a record business.

Sewing Machines.—A price advance of 20 per cent is expected on this item in the next week or ten days. Local stocks are reported in good shape. Though the movement in this line is rather slow, the spring weather will materially stimulate demand.

SEATTLE—PORTLAND

Seattle jobbers and dealers report an increase in business over the past few weeks, particularly in house-wiring devices, appliances and fractional motors. Transformers and generators are not moving to any extent, and the sale of larger size motors is very light. Complaints of slower and more unsatisfactory shipments are heard everywhere in this district.

Stocks in some lines are very incomplete, while others have vanished. Demand for certain household devices, washing machines in particular, is far in excess of supply. Eastern Washington and Oregon jobbers also report serious appliance shortages. Residence construction continues brisk, increasing from week to week. Shipyards are negotiating for new work and contract awards are not far distant. It is reported that the Northwest yards have been asked by the government to submit figures on five scout cruisers which were to have been built by the Norway Pacific yard in Everett. Lumber mills and logging camps in western Oregon and Washington are running on approximately capacity basis. The only unfavorable element in the lumber situation is said to be the continued shortage of cars.

Reports from eastern Washington power and irrigation companies state that indications point to a shortage of water this summer because of a light snowfall in the mountains. In some cases wells are being drilled and in others arrangements are being made for pumping water from other sources of supply. Confirming this condition, Spokane jobbers report increasing sales of power apparatus and pumping equipments.

In the Portland territory it is becoming more and more a problem how materials can be obtained. Orders are coming rapidly, but the factories are from six to eight months behind and the condition is rapidly growing worse. Bankers in this district are endeavoring to stabilize conditions somewhat by tightening up on loans for building projects. Retail electrical stores report that business for the past week or two has materially slowed down.

Switches.—One prominent Seattle jobber notes an increasing call for double-throw knife switches for electric range installations. The standard switch recently increased in price from 20 to 25 per cent in various quantities. Safety switches also show an increase ranging from 5 to 15 per cent.

Storage Batteries.—Business is good and increasing, but stocks are being maintained after a fashion. Prices show no advance, in spite of an advance in the price of lead. A considerable portion of the volume of sales is from towns in the outlying districts.

Sockets.—Heavy demand continues, and at present stocks are low.

SAN FRANCISCO

Building permits issued during February, 1920, were: San Francisco, $2,330,000; Los Angeles, $3,286,000; Oakland, $921,000. During February, 1919, the totals were: San Francisco, $650,000; Los Angeles, $1,008,000; Oakland, $492,000. The construction of the $50,000,000 Pacific Coast naval base in San Francisco Bay, will be delayed until 1921. In the meantime a huge warehouse is being constructed in San Diego which will be made the destroyer base for the Coast.

A 25-ft. rise in the levels of Sierra Lake used as power reservoirs has definitely removed all fear of a serious drought and will no doubt remove some of the San Joaquin Valley restriction for lighting use.

Farm Plants.—Demand has been very light but has not been felt severely because of continued poor delivery conditions from the East. Deliveries of 32-volt motors have seriously affected the growing call for appliances such as washers and cleaners.

Weatherproof Wire.—Coil lots in base sizes are selling for 34 cents per pound. Stocks are good, demands fair.

Dishwashers.—There seems to be a constantly increasing demand for family size. The Western Electric dishwasher has been temporarily withdrawn from the market, but a redesigned model on the basic principles of the first design is promised for April delivery.

Porcelain Insulators.—Insulators for 6,000 volts and other light power service have increased about 10 per cent and are selling for about 20 cents each in average quantities. The demand is light and spasmodic. Considerable local stocks are carried.

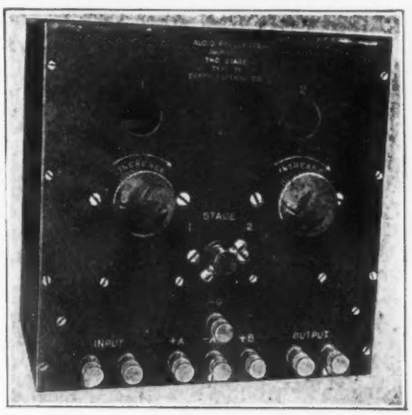
Lamp Cord.—Coast stocks are good, except in the light 1/64-in. insulation cord known as fixture-lamp cord. Because of stocks en route the Underwriters have set aside for six months, to July, 1920, the ban on this cord. This has resulted in heavy orders.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Two-Stage Radio Amplifier

A two-stage radio amplifier is being made by the Clapp Eastham Company, Cambridge, Mass. The entire instrument is mounted on one panel of bakelite, 7 in. x 7 in. A switch is provided for changing the connections for one-

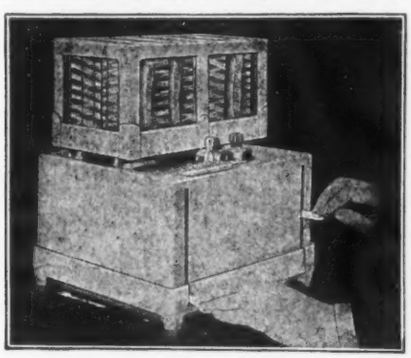


TWO-STAGE RADIO AMPLIFIER

stage or two-stage amplification as desired, and an auxiliary negative "C" battery may be connected to convenient posts. It is said that the amplification is high and particularly free from disturbing noises.

Automatic Toaster

An automatic timing arrangement to turn off the current after the toast is made is incorporated in a toaster for the use of hotels and restaurants, manufactured by the Strite Automatic Toaster Company, 422 Plymouth Build-



CURRENT AUTOMATICALLY CUT OFF WHEN TOAST IS DONE

ing, Minneapolis, Minn. After the toast is done it is automatically raised out of the machine and allowed to rest on top of the oven above the warm grid. A lever operating along a scale permits adjustment. The machine is made of polished aluminum and has five heating elements. It is made in a four-slice size, but switches are so arranged that either or both of the end elements may be cut out when toasting two or three pieces of bread. The toaster may be had for operation at either 110 volts or 220 volts and has a full capacity rating of 2,750 watts The machine is 12 in. square, 14 in. high and weighs 18 lb.

Inclosed Starter for Small Direct-Current Motors

A small starter entirely inclosed to remove danger from exposed parts and to protect the contacts from damage due to dust or spraying water has been developed by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. This starter, known as "Bulletin 2111," is to be used for small direct-current motors in exposed locations driving line shafts, fans, blowers, pumps, drills and small motor-generator sets for arc welding. It consists of the familiar type of direct-current hand starter in-

NO LIVE PARTS EXPOSED ON THIS STARTER

closed in a sheet-metal case, having an external lever which engages the movable arm of the starter. This lever is insulated from the revolving contact arm by a block of molded insulation. A pointer on the lever and legends stamped on the cover indicate whether the starter is "off" or "on." A low-voltage release coil is connected in series with the shunt field to protect the motor in case the voltage fails or the field opens while the motor is running. The armature resistor is completely inclosed in the starter case, which is ventilated by a flue in the top. Renewable contacts are provided on all starters except the smallest, which also has a black insulating composition knob in place of the lever. The inclosing case is arranged for the entrance of conduit from the under side. The starter may be mounted on any flat surface by means of four bolts. It is made in various capacities up to 50 hp., operating at 115, 230 and 500 volts.

Interchangeable Threadless Pipe Fittings

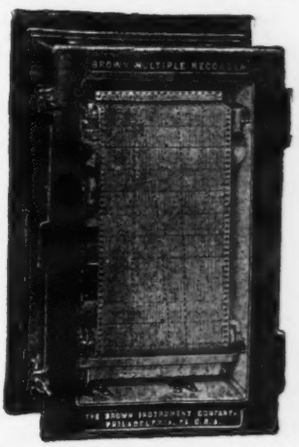
In the description of the interchangeable pipe fittings manufactured by the Erie Electrical Equipment Company printed in the ELECTRICAL WORLD of Feb. 14 a wrong address was given. The correct address of the firm is Johnstown, Pa.

Renewable Fuse Without Loose Parts

A new renewable fuse without loose parts is being placed on the market by the Monarch Refillable Fuse Company, Jamestown, N. Y. No change has been made in the link, but several improvements have been made in the container. Heavy brass machined sleeves threaded into the fiber on the inside have on each end swinging bridge pieces designed to give alignment to and prevent endwise movement of the knife blades. Heavy machined caps, into the ends of which brass washers are spun, close the ends of the containers. The ferrule type differs from the knife type in that a heavy slotted washer holds the link against the caps, which have been designed to produce as nearly perfect a contact as possible.

Multiple Recording Pyrometer

A recording pyrometer designed to take as many as ten records at one time has been developed by the Brown Instrument Company, Philadelphia, Pa. Different types of the instrument are made to give from one record up to ten. The records are made in five different colors in dotted lines. For as many as five records single dotted lines are used, and for more than that number double dotted lines are used, repeating the same five colors. The rolls are 7 in. wide with rectangular coordinates. Record paper and marking ribbon are said to last about two months before renewal and the paper may be allowed to unfold in the case



PRINTS TEN RECORDS AT ONCE

or be rerolled on a fiber tube. The instrument can be connected to any 110-volt or 220-volt line and is rated at 0.017 kw. Dry cells can be used if the energy supply should fail. The clock is self-winding.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

R. D. PATTERSON, formerly with the Northwestern Electric Equipment Company, New York City, has been appointed Eastern representative of the Lindsley Brothers Company, Spokane, Wash., with offices in the Hudson Terminal Building, 50 Church Street, New York City.

LEATHER BELTING MANUFACTURERS CONSOLIDATED.—The leather belting business of E. R. Ladew, Inc., Glen Cove, L. I., and of Graton & Knight, Worcester, Mass., has been combined through a transfer of stock. No change was effected in policy, manufacturing or personnel.

THE PEERLESS LIGHT COMPANY announces that it has moved its Chicago office to 663 West Washington Boulevard, as its former headquarters were altogether inadequate for the production of "Make-UR-Own" batteries and lighting fixtures.

L. M. WILLEY, formerly district manager of the Diehl Manufacturing Company, at Chicago, and later production manager for the company is now in charge of the sale of electrical equipment for the United States Government, New York District Salvage Board, with headquarters in New York City.

THE BAKER R & L COMPANY, Cleveland, Ohio, has transferred the business of manufacturing the Rauch & Lang electric vehicles to Rauch & Lang, Incorporated, Chicopee Falls, Mass., and it is necessary to vacate the sales and service department at 7100 Euclid Avenue, Cleveland. Wishing to provide continuous service for the many owners of these vehicles in Cleveland, the company has arranged with the R & L Service & Garage Company at 1661 East Eighty-first Street and W. C. Shultz, 11913 Detroit Ave., to continue the service which has been rendered to owners of Baker and Rauch & Lang cars.

THE STANDARD UNDERGROUND CABLE COMPANY'S Detroit sales office, which for several years has been a suboffice of the Chicago office, has been made a full branch office with R. E. Green in charge. Mr. Green has been in charge of the Detroit office since it was first opened. He has been connected with the Standard Underground Cable Company since 1909 as salesman and is well known in his territory.

THE POOLE ENGINEERING & MACHINE COMPANY, Baltimore, Md., on Feb. 1 moved its general office from 50 Churh St., New York City, to its works at Baltimore. The company will still maintain a district office at 50 Church Street. All general correspondence should be addressed to Baltimore, Md.

THE LAURAINE MAGNETO COMPANY, INC., Long Island City, N. Y., held its annual stockholders' meeting on Feb. 7, and the following officers were elected: M Feldine, president; M. G. Leslie, first vice-president; Leo Potter, second vice-president; A. C. Leslie, secretary and treasurer. There are many magnetos to be shipped for export, so far the main outlet of the company, says President Feldine, but production was enlarged and immediate steps were taken to supply the big demands of the domestic trade.

THE MONO CORPORATION OF AMERICA, 48 Coal and Iron Exchange, Buffalo, N. Y., announces that it has purchased the entire stock of Mono apparatus and accessories from the F. D. Harger Company, Buffalo, N. Y. This includes all rights for the manufacture and sale of their various types of Mono apparatus for the automatic analysis of CO_2, CO, O_2, H_2, SO_2, N_2, C_1, etc. F. D. Harger has not severed his connection, but will serve as general manager of the new corporation. A service and inspection department connected with the laboratory is now in operation and a chemical engineer in charge.

E. A. THORNWELL has recently organized a manufacturers' agency for railway and power equipment with offices at 1026-7 Atlanta Trust Company Building, Atlanta, Ga. Agents' arrangements have been completed with seven manufacturers of power station and electric railway supplies. Among power companies he will handle the Bennett lightning arrester made by the Electro Service Company, of Marietta, Ga. He will also handle the Valentine-Clark Company's cedar poles and will later have a complete line of outdoor switching and protective equipment. For a number of years Mr. Thornwell has held a responsible position as district representative of the Westinghouse Electric & Manufacturing Company, as representative from the Atlanta district office.

PAGE STEEL & WIRE ACQUIRED BY AMERICAN CHAIN.—The American Chain Company, Inc., Bridgeport, Conn., has purchased the control of the Page Steel & Wire Company, with mills at Monessen, Pa., and Adrian, Mich. It is the intention of the American Chain Company to continue the business of the Page Steel & Wire Company as heretofore, taking only its surplus product. The latter's plants consist of open-hearth furnaces, rolling mill and wire mills, as well as fence factories. The officers elected under the reorganization of the company are: Walter B. Lashar, president; William T. Morris, vice president; Wilmot P. Wheeler, treasurer; John E. Carr, assistant treasurer, and William M. Wheeler, secretary. E. C. Sattley, general manager of the Page Steel & Wire Company, will continue in that capacity with offices in Pittsburgh, Pa. The American Chain Company has its general sales offices in the Grand Central Terminal Building, New York City, and district sales offices in Chicago, Boston, Philadelphia, San Francisco, Portland and Pittsburgh.

WESTINGHOUSE CHANGES. — Announcement has been made by the Westinghouse Electric & Manufacturing Company of the appointment of W. S. Rugg, manager of the railway and marine departments, and Charles Robbins, assistant sales manager, as assistants to vice president. Mr. Rugg's service with the company dates from the early days of its growth. Soon after his connection with the organization he was transferred from Pittsburgh to Chicago, and in 1901 he was transferred to New York as special engineer, becoming manager of the New York office eight years later. In 1917 he was recalled to East Pittsburgh to take charge of the railway dapartment, and in 1918 he was also made manager of the newly created marine department. Mr. Robbins began his connection with the company in 1899 at its New York office. He was transferred in 1906 to the main offices at East Pittsburgh as assistant to manager of the industrial and power departments. He retained this position until his appointment to the position of manager of the industrial sales department in 1910. In August, 1915, he was made assistant sales manager of the company, from which he was promoted to his present position. Myles B. Lambert, for many years connected with the railway department, has been appointed manager of that department.

THE RADIANT MANUFACTURING Company, Sandusky, Ohio, which announces that its output over the last two years has been entirely taken by a small number of large jobbers, will soon inaugurate a vigorous advertising campaign among dealers and farmers, under the direction of A. H. Ambrose, who has just been appointed advertising manager. Mr. Ambrose was for the last eight years assistant advertising and sales promotion manager for the Associated Manufacturers' Company, Waterloo, Iowa, and has also had wide experience in the manufacture and sale of farm-lighting plants. He expects 1920 sales to treble 1919 production.

EDWARD T. FOOTE, for the last three years manager of the New England office of the Cutler-Hammer Manufacturing Company, with headquarters at Boston, Mass., has been transferred to the clutch and magneto department of the Milwaukee factory. His successor has not yet been named.

THE EASTERN ASBESTOS COMPANY has been established with offices at 417 Grosvenor Building, Providence, R. I., and the company will sell both standard and special asbestos products, including yarn, tape, cord, cloth, twine, listing, gaskets, carded fiber, gasket cloth, friction disks, sheet and high-pressure packing. P. O. Baker, who has been in the electrical industry for the last eighteen years, is manager. Mr. Baker has just resigned as purchasing agent of the D & W Fuse Company, Providence, and was formerly employed by the Western Electric, and Simplex Wire & Cable companies.

THE PELTON WATER WHEEL COMPANY, San Francisco, Cal., has announced the recent appointment of W. D. Ward as manager of its Atlantic department at 90 West Street, New York City. Mr. Ward has been associated with the company for more than twenty-five years, having been the ranking sales engineer in the home office at San Francisco previous to his assumption of the post in New York.

THE AMERICAN ARMATURE ENGINEERING COMPANY, Bluefield, W. Va., has let contracts for a plant, 40 x 100 ft., at Mullins, W. Va.

THE HARTFORD BATTERY MANUFACTURING COMPANY, Hartford, Conn., has increased its capitalization from $250,000 to $350,000 for general business expansion.

THE NEW MICA COMPANY, Auburn, N. Y., has just announced a capital increase from $20,000 to $60,000.

THE U. S. BATTERY COMPANY, 157 West Fifty-fourth Street, New York City, has planned for the immediate erection of a four-story brick and steel structure, about 72 ft. by 100 ft., at 161-67 West Sixty-fourth Street, to cost $100,000.

THE MINIATURE INCANDESCENT LAMP CORPORATION, Newark, N. J., has made plans to acquire a three-story building at Eighth Avenue and High Street, to be used for a new works.

WILLIAM T. POULTERER, who for a number of years has been engineer with the Philadelphia Electric Company Supply Department, has resigned and become engineer of the Electrical Development & Machine Company, Philadelphia. The Philadelphia Electric Company Supply Department formerly acted as sales agents for the line of "Franklin" central-station specialties, manufactured by the Electrical Development & Machine Company, but since the first of the year the Eastern territory has been handled by the Utility Products Corporation, New York City, while the rest of the field is being handled direct by the manufacturer.

THE CHICAGO PNEUMATIC TOOL COMPANY on Jan. 21 and 22 held a general conference of executives, plant and branch managers and salesmen at its Detroit plant, Second Avenue and Amsterdam Street, on the occasion of the formal opening of a large five-story addition. It was reported that much of the proposed increase in production was already absorbed by orders for future deliveries.

THE ANDERSON ELECTRIC & EQUIPMENT COMPANY, Chicago, is the new name of the Anderson Electric Specialty Company. There is no change either in the officers or the company's organization. The change has solely been made to render the corporate name more descriptive of the character of the products manufactured by the company and to eliminate the word "specialty," which the company says does not properly describe the Anderson lines these being staple articles known and sold throughout the world.

THE ELECTROLABS COMPANY is consolidating its officers at 2635 Penn Avenue, Pittsburgh, Pa., with a branch office at 30 Church Street, New York City.

THE UNITED STATES RUBBER EXPORT COMPANY, LTD., New York City, export division of the United States Rubber Company, is, through its wire division, as conditions warrant, adding to its facilities for the exportation of rubber-insulated electrical wires, cables, tapes, etc., manufactured at its plant at Bristol, R. I. Already twelve direct branches and numerous distributers carrying stocks of these commodities are successfully operating in important centers of the world. Sales are showing a gratifying increase year by year. The promotion of export wire and cable sales is handled from the New York office, H. C. Morehouse in charge.

THE STERLING VARNISH COMPANY, PITTSBURGH, PA., announces that Alvin S. King, its Eastern manager for many years, died in New York after a short attack of pneumonia on Feb. 3.

THE BLACK & DECKER MANUFACTURING COMPANY, Baltimore, Md., announces the establishment of a permanent office and showroom at 1436 South Michigan Avenue, Chicago, in charge of R. G. Ames, whose territory has been extended to cover the entire Mid-West. F. E. Marrion and J. N. LaBelle will assist Mr. Ames.

THE MALONEY ELECTRIC COMPANY intends to combine its four St. Louis factories into one large plant and is seeking a tract of land from 10 to 15 acres in size for this purpose. Enlarged production at earliest possible time is desired.

Supply Jobbers' Notes

F. W. GREUSEL, president of the G.-Q. Electric Company, Milwaukee, Wis., announces the company's removal to 23-25 Erie Street. The new location gives 35,000 sq.ft., which is considerably over the former capacity. The company is inaugurating several departments for handling household appliances, farm lighting plants and other electrical specialties. It is also increasing its sales organization to care for anticipated increases in business and is operating on a wholesale basis only, cooperating with local contractors and dealers as much as possible.

W. H. VILETT and HARRY BOHN, who formerly operated the Sterling Electric Company, Minneapolis, Minn., have purchased the household appliance section of the Sterling Electric Company's business and disposed of the company's jobbing and contracting business. The name of the household appliance department has been changed to the Gainaday Electric Company, and it will continue to operate at 29 South Fifth Street, Minneapolis, Minn. The new Gainaday Electric Company will sell Gainaday washing machines, Simplex ironers, Rudd automatic water heaters, Ohio Truex vacuum cleaners, electric dish washers, White electric sewing machines and Minneapolis heat regulators. The company plans to do an appliance business of $1,000,000 in 1920. Prior to the segregation of the company's business, Mr. Vilett was for twenty years in the electrical industry in the Northwestern states. Mr. Bohn was the manager of the household appliances department of the Sterling Electric Company.

W. H. VILETT

PETTINGELL-ANDREWS COMPANY ISSUES HOME-WIRING BOOKLET.—A twenty-four page booklet, "The Relation of Electricity to the Proper Planning of the Home," has just been published by the Pettingell-Andrews Company, electrical supply jobber, Boston, Mass. It is designed to aid home owners, home builders, architects and electrical contractors in the layout of electrical outlets and wiring, fixtures and household conveniences in harmony with the best modern practice from the esthetic and the utilitarian side. The booklet closes with an outline of the growth of the company from a small one-room shop in 1886 to the present establishment of 100,000 sq.ft. of floor area, with its electrical and illuminating engineering and fixture-designing departments, sales service and organization.

Foreign Trade Notes

AUSTRALIAN WIRE IMPORTS.—It is reported that the revised conditions under which rubber-covered wire may be imported into Australia will come into operation April 1.

ELECTRICAL EQUIPMENT NEEDED IN TAMPICO.—Consul Dawson reports the need of electrical equipment in Tampico, Mexico. Never, he states, has the supply been equal to the demand. The present shortage is stated to be holding back developments there. This is a prosperous oil country. Names of those interested in building operations there may be had by referring to file No. L. A. 44, Bureau of Foreign and Domestic Commerce.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

P. Ravet, electrical engineer, has opened an office at 17 Cours de Vincennes, Paris, France, and desires representation of high-grade American electrical goods.

A Brazilian firm (No. 31,995) through its United States agent would like to represent an American manufacturer of incandescent lamps.

A man in Switzerland (No. 31,950) wishes to purchase and secure an agency for electrical heating and cooking apparatus. Payments to ninety days through bank.

A merchant in India (No. 32,044) is looking for an agency for electrical goods. Payment through bank in Bombay.

An Australian (No. 32,062) wishes to secure an agency for automobile-starting batteries and also for farm-lighting plants up to 2,500 cp. Cash against documents.

The representative of an American firm is looking for an agency in Holland (No. 31,973) for electrical measuring instruments and appliances. Cash against documents.

An electric lighting company in Chile (No. 31,990) is in the market for electric equipment. Plans may be secured upon application to the company.

Government contractors in Egypt are in the market for electrical supplies on a commission basis. American bank credit against documents.

Trade Publications

REFLECTORS.—"Hubbell Reflectors for Industrial Plant Lighting" is the title of a recent catalog of Harvey Hubbell, Inc., Bridgeport, Conn.

FIXTURE PARTS.—Catalog No. 21 of the Lightolier Company, New York City, is descriptive of its interchangeable fixture parts.

HEADLIGHTS.—The Ohio Brass Company, Mansfield, Ohio, has issued price list No. 206, applying to catalogs 201, 202, 202A, 203 and 205, on Crouse-Hinds "Imperial" headlights, both arc and incandescent.

CIRCUIT BREAKERS.—Bulletin No. 47,448, superseding bulletin No. 47,400, has recently been issued by the General Electric Company, Schenectady, N. Y., descriptive of its types FK-12 and FK-12-B oil circuit breakers up to 22,000 volts.

WASHING MACHINES.—A pictorial story of the production methods and the organization work of the Hurley Machine Company is given in a thirty-two-page booklet entitled "Where the Thor Is Made," by the Hurley Machine Company, Chicago, Ill.

ASBESTOS-COVERED WIRE.—A catalog on Rockbestos, describing asbestos-covered wires and cables for every service, has been issued by the Marlin-Rockwell Corporation, Insulated Wire Division, New Haven, Conn.

REFLECTORS.—"How to Make Reflectors Reflect" is the title of a folder sent out by the Thompson Electric Company, Cleveland, Ohio.

ELECTRIC HEATER.—A new small folder describing electric space heaters, known as publication 494, has been issued by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

COMMUTATOR BRUSHES.—The Graphite Products Company, Germantown, Philadelphia, has issued its 1920 catalog and price list relative to fiber graphite commutator brushes and Ward carbon and metal brushes.

New Incorporations

THE COUNTRY HOME POWER & LIGHTING COMPANY of Louisville, Ky., has been incorporated by W. G. Simpson, Jr., of Louisville; Hubert and Graham Vreeland of Frankfort, Ky. The company is capitalized at $30,000 and proposes to operate an electric light and power plant.

THE VALLEY DEVELOPMENT COMPANY of Brattleboro, Vt., has been incorporated by Robert Fitts, H. C. Fenton and G. E. Murphy, all of Brattleboro, Vt. The company is capitalized at $50,000 and proposes to develop a hydro-electric project in the southern part of the state.

THE BRIER HILL (N. Y.) ELECTRIC LIGHT & POWER COMPANY has been incorporated by F. E. Graves, A. W. Gregory and M. L. Stevenson of Brier Hill. The company is capitalized at $10,000 and proposes to generate and distribute electricity for lamps and motors in Brier Hill.

THE EASTERN UTAH ELECTRIC COMPANY of Price, Utah, has been incorporated with a capital stock of $75,000. The officers are: Neil Madsen, president; N. S. Neilsen, vice-president and Harold Leonard, secretary.

THE THREE RIVERS ELECTRIC LIGHT & POWER COMPANY of Des Moines, Ia., has been incorporated with a capital stock of $500,000 to supply electricity for lamps and motors to the farmers and small towns in central Iowa. The officers are: H. E. Slack, president; C. F. Keeling, vice-president; Fred F. Kethley, secretary, and C. A. Willett, treasurer.

J. I. ROBIN & SONS, INC., of New York, N. Y., has been incorporated by E. London, J. I. and B. J. Robin, 130th Street and Park Avenue, New York City. The company is capitalized at $250,000 and proposes to manufacture brass and other electric and gas fixtures.

THE ELECTRIC SUN COMPANY of Asbury Park, N. J., has been incorporated with a capital stock of $80,000 to manufacture electric signs. The incorporators are Charles T. Day, Arthur J. Haight and Albert Klebs.

THE MOUNTAIN STATE ELECTRIC COMPANY of Charleston, W. Va., has been incorporated by R. S. White, H. R. Sapp and Fred O. Blue. The company is capitalized at $100,000 and proposes to construct and operate an electric power plant and system.

THE CITRONELLE (ALA.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000 by John A. Burt, A. G. Woodbury and J. S. Lynch.

THE PEOPLE'S ELECTRIC COMPANY of Marianna, Ark., has been chartered with a capital stock of $50,000. The officers are: M. D. Miller, president, and D. G. Norment, secretary and treasurer.

THE MENARD (TEX.) LIGHT & ICE COMPANY has been incorporated with a capital stock of $30,000 by A. E. Nauwald, Peter Anderegg and W. M. Bevans.

New England States

HERMON, ME.—The Black Stream Electric Company contemplates the construction of a 1-mile feeder line. H. H. Leathers is manager.

MOUNT DESERT ISLAND, ME.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has postponed date of receiving bids for construction of new electric transmission station (Specification 4135) at the local yard from March 3 to March 17. C. W. Parks is chief of the bureau.

PORTLAND, ME. — The Cumberland Power & Light Company has petitioned the City Council for permission to lay conduits in certain streets in the city.

PORTLAND, ME.—The Central Maine Power Company is negotiating for the purchase of the Androscoggin Electric Company, Oxford Electric Company and Knox County Electric Company. After the transfer the company plans extensive improvements, to include several new power stations, transmission lines, etc.

SKOWHEGAN, ME.—Bids will be received until March 15 by the Central Maine Power Company for the construction of a power house with complete electrical equipment, including five turbine waterwheels, each of which will develop 4,300-hp., and a dam. The cost is estimated at $100,000. J. A. Leonard is engineer.

VINAL HAVEN, ME.—The construction of a transmission line to North Haven is contemplated by the Vinal Haven Light & Power Company A. A. Peterson is manager.

SOMERSWORTH, N. H.—The Great Falls Manufacturing Company plans to build a mill at Somersworth, to cost about $4,500,000. Electricity will be used for motive power.

FITZDALE, VT.—The Fitzdale Paper Company has broken ground for power-plant extensions, to cost about $10,000, including machinery and equipment. The C. A. Conrad Construction Company, Fitzdale, is the building contractor. J. F. King is treasurer.

MORRISVILLE, VT.—The village has voted to purchase the mill property and power plant of H. A. Slayton & Company to increase the municipal electric service.

BOSTON, MASS.—The Eastern Massachusetts Electric Company contemplates extending its transmission system from West Peabody to Danvers. R. S. Tenney is assistant treasurer.

BOSTON, MASS.—The Edison Electric Illuminating Company, it is reported, has purchased a site on the Weymouth, Fore River, at North Weymouth, on which, it is said, it will erect a large power plant, to cost about $4,000,000.

BROCKTON, MASS.—The installation of two 600-hp. boilers and the construction of 10 miles of 13,000-volt transmission line is contemplated by the Edison Electric Illuminating Company. A. F. Nelson is manager.

BROOKLINE, MASS.—The Board of Selectmen has recommended an appropriation of $80,000 for street lighting for the coming year, of which $6,000 will be used for the installation of an ornamental lighting system at Coolidge Corner.

FRAMINGHAM, MASS. — Considerable electrical and mechanical equipment will be required in connection with the proposed addition to the plant of the Roxbury Carpet Company.

GROTON, MASS.—The construction of a new copper trunk transmission line from Ayer is contemplated by the Electric Light Commissioners. W. H. Dodge is superintendent of plant.

LOWELL, MASS.—The installation of a 12,500-kw. turbine with boilers and auxiliaries and the construction of 2 miles 13,000-volt transmission line is contemplated by the Lowell Electric Light Corporation. J. A. Hunnewell is manager.

NEW HAVEN, CONN.—The Model Laundry Company, City Point district, is having plans prepared for an addition to its works, extension in boiler plant and the erection of a garage. Considerable electrical and mechanical equipment and laundry machinery will be required.

Middle Atlantic States

BERKSHIRE, N. Y.—The Public Service Commission has granted the Delco Lighting Company permission to construct and operate an electric plant in Berkshire. The company has also been granted permission to issue $6,000 additional capital stock.

BROOKLYN, N. Y.—Arrangements have been completed by the Brooklyn Edison Company for the issuance of $3,000,000 in bonds. Part of the proceeds, it is understood, will be used for extensions and improvements.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

BROOKLYN, N. Y.—Plans have been prepared by P. M. Marko & Company, Atlantic Avenue, between Nostrand and New York Avenues, for the construction of an addition to their plant. Alterations and improvements will also be made in the existing building. The company manufactures storage batteries.

BROOKLYN, N. Y.—Bids will be received until March 19 by the Superintendent of Buildings, Board of Education, Municipal Building, Manhattan, for the installation of electrical equipment in Public School 144, in connection with alterations and an addition to building.

BYRON, N. Y.—The Genesee Light & Power Company has been granted permission by the Public Service Commission to construct an electric light and power plant at Byron, and also approval of a franchise granted by the Byron town officials. W. C. Lewis is president and treasurer.

CAYUGA, N. Y.—The village contemplates holding a special election to vote on the proposal to install an electric lighting system, the service to be furnished by the Empire Gas & Electric Company.

NORTH TONAWANDA, N. Y.—The capital stock of the North Tonawanda Power Company has been increased from $750,000 to $2,000,000, for general business expansion.

OSSINING, N. Y.—Bids wil be received until March 23, by C. F. Rattigan, superintendent of state prisons, Capitol, Albany, for construction of undeground electric conduit feeder system and pump house for Sing Sing prison. L. F. Pilcher, Capitol, Albany, is state architect.

SYRACUSE, N. Y.—The Du Pont Engineering Corporation of Wilmington, Del., has been awarded contract for construction of plant, including complete power and transmission system for the Brown-Lipe-Chapin Company, 110 Seneca Street, to cost about $700,000.

PLEASANTVILLE, N. J.—The Public Utility Commission has granted the Atlantic City Electric Company permission to take over the property and holding of the Pleasantville & Shore Electric Company.

SUMMIT, N. J.—Plans are under consideration by the Common Council for the construction of a new electrically operated pumping station to be used in connection with its sewage disposal plant.

SUMMIT, N. J.—The Commonwealth Electric Company is reported to be considering plans for the erection of an addition to its plant.

ALTOONA, PA.—The city will receive separate bids for the purchase and erection of 48 new metal artificial-design lamp standards during March. The estimated cost is $11,000. F. D. Hain, City Hall, Altoona, is engineer.

McKEE'S ROCKS, PA.—Arrangements are being made by the Common Council for the installation of a new electrically operated fire-alarm system.

OXFORD, PA.—The Oxford Electric Company plans to extend its transmission system at an expenditure of approximately $100,000. J. H. Ware is manager.

RIDGWAY, PA.—The Ridgway Electric Light Company contemplates the installation of one 5,000-kva. turbo generator, boiler and condenser equipment, and also the erection of about two miles of 22,000-volt transmission line. W. H. Brown is superintendent.

SOUDERTON, PA.—The Souderton Light & Power Company contemplates the construction of a three-phase transmission system. J. J. Hutchinson, manager.

BALTIMORE, MD.—The Board of Trustees of Johns Hopkins Hospital has had plans prepared for the installation of a new heating and lighting plant in connection with the proposed seven-story addition.

CUMBERLAND, MD.—The plant of the Wellington Glass Company, manufacturer of lighting fixtures, was destroyed by fire on Feb. 29. The loss estimated at about $350,000.

ELKTON, MD.—Arrangements have been completed by the Oxford Electric Light Company for the purchase of the electric light plant of the Tome Institute at Port Deposit, Md. Plans are also being prepared for the erection of a new power line from Oxford to Rising Sun.

HUNTINGTON, W. VA.—The Consolidated Light, Heat & Power Company contemplates the construction of an 11,000-volt transmission line from Kenova to Huntington, and an 11,000-volt line in Huntington. H. L. Evans is superintendent.

MULLENS, W. VA.—The Union Powder Company, recently incorporated, has purchased the property of the Mullens Light & Power Company. Extensive improvements, including the installation of a street lighting system, are contemplated. The main office of the company is at Charleston, W. Va. S. T. Preston is general manager.

SOUTH CHARLESTON, W. VA.—The Bureau of Yards & Docks, Navy Department, Washington, D. C., contemplates the construction of an outdoor electric substation at the local naval station, to cost about $40,000.

BLACKSBURG, VA.—The trustees of the Virginia Polytechnic Institute contemplate the installation of a complete new generating system in the heat and power plant. W. E. Ellis is director.

FRONT ROYAL, VA.—The installation of two new waterwheels, one waterwheel governor, one generator, new switchboard equipment and other improvements in the municipal electric light plant is contemplated. D. W. Harrison is superintendent.

SHENANDOAH, VA—The installation of a 300-kva. generator in the municipal water and light plant is contemplated. A. V. Kern is superintendent.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 25, for furnishing and installing lighting fixtures in United States post offices at Bellefourche, S. D.; Decatur, Ala.; Denton, Tex.; Eldorado, Kan.; Honey Grove, Tex.; Mount Pleasant, Mich.; Rhinelander, Wis.; Sunbury, Pa., and the post office and court house at Woodward, Okla.

North Central States

CAMDEN, MICH.—The construction of transmission lines to Ray, Ind., and Frontier, Mich., is contemplated by the Economy Electric Company. S. P. Hull is secretary.

CARO, MICH.—The Caro Light & Power Company contemplates the installation of a three-phase generator. N. B. Atwood is manager.

CASS CITY, MICH.—The installation of a steam-driven 2,300-volt generator, and possibly a water works pump, in the municipal electric light and water plant, is under consideration. W. N. Straube is superintendent.

DETROIT, MICH.—The Commissioner of Purchases and Supplies, Municipal Courts Building, will receive bids until March 16 for furnishing a complete stoker with steam engine for installation in the municipal light plant.

DETROIT, MICH.—The Department of Public Works contemplates the installation of two 800-hp. boilers, one 600-hp. boiler, feed-water heater and a 150-kw. motor-generator in connection with new two-story steam-power building. The cost of the equipment is estimated at $250,004. Esselstyn, Murphy & Hanford, Marquette Building, are the engineers, and J. Scott & Company, 2326 Dime Bank Building, are architects.

GLADWIN, MICH.—The construction of a new 33,000-volt transmission line to Beaverton is contemplated by the Gladwin Light & Power Company. S. B. Wiggins is superintendent.

MONTGOMERY, MICH.—The construction of a 4 mile transmission line to Roy is contemplated by the Economy Electric Company. S. P. Hull is manager.

OTTER LAKE, MICH.—C. C. Tinker, owner of the local electric light plant, contemplates the construction of a 13,200-volt transmission line to Mayville, a distance of 7 miles.

RIVER ROUGE, MICH.—The Board of Education contemplates the construction of a high school, for which considerable electric equipment will be required. The estimated cost is $750,000. VanLeyen, Schilling & Keough, Union Trust Building, Detroit, are architects and engineers.

ADA, OHIO.—The installation of new engines, generators and water pumps is contemplated by the Ada Water & Light Company.

ARCHBOLD, OHIO. — The Archbold Electric Light & Power Company contemplates construction of transmission lines into the farming districts. T. S. De Vries is the president.

CAREY, OHIO—Plans are being prepared by W. Frolough & Emery Company, engineers, Toledo, to rebuild the municipal electric light plant on West Findlay Street. The project will require entire new equipment, including one alternating-current 60-cycle generator. M. C. Reynolds is superintendent and chief engineer.

CLEVELAND, OHIO.—The capital stock of the Cleveland Electric Illuminating Company has been increased from $18,000,000 to $30,000,000.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until March 19, for furnishing electric meters for division of light and heat.

CLEVELAND, OHIO.—E. Shattuck, city purchasing agent, will receive bids until March 19, for furnishing 1,900 electric meters for heat and light division. The estimated cost is $19,000.

COSHOCTON, OHIO.—The Ohio Service Company contemplates the installation of two new boilers in connection with coal handling system, additional water supply for generating system, and also the construction of 35 miles 33,000-volt, double-circuit transmission lines. J. J. Dolan is superintendent of power.

DAYTON, OHIO.—The city is considering proposals to abandon gas for street-lighting purposes and to use electric lamps throughout the entire city after the present contract expires in April. A. Barlow is City Manager.

GALION, OHIO.—The installation of one 1,000-kw. turbo-generator in the municipal electric light plant is under consideration. H. C. Dye is superintendent.

SPRINGFIELD, OHIO.—The Springfield Light, Heat & Power Company contemplates the installation of one new 8,000-kw. Westinghouse turbine, condenser and auxiliaries. B. C. Cobb is president.

PADUCAH, KY.—The Paducah Traction & Light Company, it is reported, contemplates improvements including the reconstruction of the local street-car lines and various installations in its power and light plant.

EVANSVILLE, IND.—The Evansville Paint & Varnish Company, 311 First Street, is having preliminary plans prepared for the construction of a power plant on Columbia Avenue. H. D. Bourland is president.

FOUNTAIN CITY, IND.—The Winchester (Ind.) Heat, Light & Power Company has contracted with the authorities of Fountain City to extend its transmission lines to Fountain City and to supply electrical service. The lines will be rebuilt to carry the added current. The company is arranging to install a 500-hp. engine at its plant in Winchester.

GARY, IND.—The National Tube Company, a subsidiary of the United States Steel Corporation, is planning to build a new plant east of Gary harbor, to cost about $40,000,000. The company will also build a street railway to the plant, at a cost of about $1,000,000. Work on four blast furnaces will begin at once and will be followed by the erection of tube mills, shops, office buildings and other structures. The company also plans to build a large number of houses at Gary for its employees.

INDIANAPOLIS, IND.—The Interstate Public Service Company of Indianapolis has petitioned the Indiana Public Service Commission for authority to sell $226,000 stock. The company furnishes electricity for lamps and motors in a number of counties in Indiana.

SHELBYVILLE, IND.—The Interstate Public Service Company has asked the Indiana Public Service Commission for permission to erect a transmission line from Shelbyville to the Shelby-Johnson County line, where it will connect with a line to be extended from Franklin.

MOLINE, ILL.—A joint petition has been filed with the Public Utilities Commission to authorize the People's Power Company of Rock Island to sell electricity to the Coe Light & Power Company in Port Byron and Coe Townships and for the joint use of the poles of the People's Power Company by the Coe Light & Power Company.

SHERRARD, ILL.—The Sherrard Electric Light Company contemplates extending its lines from Orion to Lynn and Osco.

WEST BEND, WIS.—The Young America Electric Machine Company, Young America, near West Bend, has had plans prepared for the construction of a plant, about 44 ft. x 122 ft., two stores. F. Woodfort is manager.

ELY, MINN.—The installation of three Heine boilers with a capacity of 213 hp. and a new condenser in the municipal electric light plant is contemplated. W. Mitchell is superintendent.

GRANITE FALLS, MINN.—Plans are under consideration to increase the generating capacity of the municipal electric light plant. A. W. Thompson is manager.

MADISON, MINN.—The installation of an 18-ft. x 72-ft. horizontal boiler in the municipal electric light plant is under consideration. T. B. Leasman is manager.

BOLIVAR, MO.—Extensions and improvements are contemplated to the municipal electric light plant, including the installation of a larger generating unit. A. F. Leavitt is the light and water commissioner.

DEADWOOD, MO.—The St. Joseph Lead Company of 61 Broadway, New York City, is planning to build a power house in Deadwood. Stone & Webster, 120 Broadway, New York City, are the contractors.

KANSAS CITY, MO.—The City Council has authorized cables to be laid on Baltimore Avenue between Twelfth Street and Southwest Boulevard, before paving, for the proposed ornamental lighting system. Single-lamp standards will be used, the expense to be borne by property owners.

MOUNTAIN GROVE, MO.—The Mountain Grove Light & Power Company plans construction of a dam, power plant and transmission lines to supply hydro-electric power to the towns of Mountain Grove, Willow Springs, Cabool, Hansfield and Gainesville. The dam and power plant will be located at Double Springs.

TOWNER, N. D.—The installation of a new semi-Diesel engine is contemplated by the Towner Light & Power Company. T. K. Strand is president.

LINCOLN, NEB.—The municipal electric light and water department is planning to build a new plant, to be equipped with new turbine, boilers, coal conveyor, etc. P. W. Doerr is superintendent.

MORRILL, NEB.—The installation of a 100-hp. directly connected unit in the municipal light and power plant is under consideration. O. T. Moline is the clerk.

RANDOLPH, NEB.—The installation of an alternating-current generator in the municipal electric plant this spring is under consideration. R. J. Kirk is secretary and district superintendent.

SCHUYLER, NEB.—The Light and Water Commissioners contemplate the construction of a new generating room and the installation of new equipment, including one 125-kva. and one 210-kva. unit; also new switchboard and street-lighting equipment. E. A. Schmid is chairman of the Light and Water Commission.

SCOTIA, NEB.—The installation of a new engine and generator, as well as an 11,000-gal. distilling tank, is contemplated by the municipal electric light department.

BURLINGAME, KAN.—The installation of a 500-kw. turbo-generator and a 250-hp. Heine boiler and also the construction of a new engine room and spray pond for cooling water at the municipal electric light plant are under consideration. H. R. Williams is superintendent.

LA CYNGE, KAN.—The installation of one 75-kw., 2,300-volt, 60-cycle generator in the municipal electric light plant is contemplated, and also the erection of additional pole lines and transformer. W. W. Petifish is superintendent.

MORAN, KAN.—The municipal electric light and water department contemplates rebuilding its transmission line. M. M. Humphrey is superintendent.

OTTAWA, KAN.—The City Commissioners contemplate the construction of a new dam to cost about $25,000 and the installation of a new boiler at the municipal water and light plant and erection of a 17-mile transmission line to Richmond.

PRETTY PRAIRIE, KAN.—The installation of one 70-kva., 2,300-volt, 60-cycle, three-phase generator in the municipal electric light and power plant is under consideration. J. J. Siebert is manager.

ST. FRANCIS, KAN.—The installation of a new generating unit in the municipal electric plant some time this year is under consideration. W. Roelfs is superintendent.

Southern States

WAKE FOREST, N. C.—Bids will be received until March 25 by the Mayor and Commissioners for construction of waterworks and sewerage systems, including, for the former, five miles of 6-in. to 10-in. pipe; valves, hydrants, pumping stations, tower and tank, motor-driven pumps, etc. Plans and specifications may be obtained from W. M. Platt, engineer, Durham, N. C.

WILMINGTON, N. C.—The Delgrado Cotton Mills have contracted with the Tidewater Power Company to supply electricity to operate the entire plant and an extension. Orders have been placed for motors, transformers, substations, etc. An additional transmission line will be erected from the power house to the Delgrado plant.

CHARLESTON, S. C.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to erect a 300-ft. radio station, with foundation at the local navy yard. The estimated cost is $17,000.

GADSDEN, ALA.—The Gulf States Steel Company of Birmingham, it is reported, contemplates the installation of a turbo-electric generating plant at its local plant, the equipment to include 4,000-kw. steam turbines driven by waste steam, to cost about $350,000. N. Rybitski of New York, N. Y., is engineer.

EDWARDS, MISS.—An election will be held March 22 to vote on the proposal to issue $7,500 in bonds for construction of an electric light plant.

DE WITT, ARK.—The De Witt Rice Mill Company is in the market for electrical equipment for a rice mill. The cost of mill is estimated at $300,000.

ALEXANDRIA, LA.—The installation of one 200-hp. motor-driven air machine in the municipal electric light plant and waterworks system is contemplated.

BOYCE, LA.—Bids will be received until March 18, by the Mayor and Board of Aldermen for improvements to the municipal electric light and waterworks plant, including crude-oil engines, alternators, fire pumps, air compressor, oil-storage tank, power station building and machinery foundation. X. A. Kramer, Magnolia, Miss., is consulting engineer.

DE RIDDER, LA.—The installation of a 250-hp. engine and a 200-kva. General Electric generator is contemplated by the De Ridder Light & Power Company. M. B. Morgan is treasurer.

JENNINGS, LA.—The Public Service Company of Southwest Louisiana contemplates changing its system from direct to alternating current. C. L. Pardee is assistant manager.

NATCHITOCHES, LA.—The installation of two 150-hp. crude-oil engines and one 125-kva. generator in the municipal electric light plant and waterworks is contemplated. G. J. Shehane is superintendent.

ANADARKO, OKLA.—The installation of two 200-hp. Diesel oil engines in the municipal light and water plant is contemplated. N. A. Kunkel is superintendent.

BARTLESVILLE, OKLA.—The installation of a 1,000-kw. turbine and the construction of two feeder lines is contemplated by the Bartlesville Gas & Electric Company. W. W. Lowe is manager.

CLEVELAND, OKLA.—The Oklahoma Utility Company contemplates the installation of one gas engine unit in its plant. H. C. Warfield is manager.

FAIRFAX, OKLA—The Fairfax Light, Heat & Power Company contemplates the installation of a 200-hp. engine and a 170-kva. generator. C. I. Huffaker is manager.

KINGFISHER, OKLA.—The installation of one 500-kw. turbo generator unit in the municipal electric light and water plant is under consideration. E. Fisher is superintendent.

ECTOR, TEX.—The city contemplates construction of a municipal electric light plant.

SAN AUGUSTIN, TEX.—Contracts have been placed for machinery for the proposed municipal electric light plant. Equipment, including wire, poles, etc., for distributing system has not yet been purchased.

Pacific and Mountain States

SEATTLE, WASH.—The Post Street station of the Puget Sound Traction, Light & Power Company, at Western Avenue and Post Street, was wrecked by an explosion recently.

WHITE BLUFFS, WASH.—Tentative plans are being made by the Whjte Bluff Irrigation District for development of a district of 60,000 acres, to cost about $1,000,000. The project includes a hydro-electric development at Priest Rapids.

CONDON, ORE.—The Condon Electric Company contemplates the installation of one 100-hp. Fairbanks-Morse Company oil engine and one 125-kw. generator during the summer. A. B. Brower is the engineer.

PORTLAND, ORE. — Application has been filed by E. G. Hopson, Central Building, with P. A. Cupper, state engineer, Salem, for diversion of 1,200 sec.-ft. of water from Metolius Creek for power purposes. The project will involve construction of dam, canal and headgate and the installation of 43,000-hp. electric generators, to cost about $1,500,000.

FRESNO, CAL.—The San Joaquin Light & Power Corporation contemplates the installation of a 12,000-kva. steam turbine in connection with its hydro-electric development on King's River, and also the erection of transmission lines. E. J. Crawford is assistant general superintendent.

GARFIELD, UTAH.—The Utah Copper Company, it is reported, contemplates the construction of a power plant to operate the concentrators at the Garfield plant and possibly at Bingham.

OGDEN, UTAH.—T. P. Mosso, electrical contractor of Spokane, Wash., has been awarded contract for installing electrical machinery and fixtures to cost about $100,000 in the flour mill under construction at Odgen for the Sperry Flour Company. Electrical equipment to generate 1,600 hp. will be installed and also 3,000 lighting fixtures.

Canada

WINNIPEG, MAN.—Bids will be received by the chairman of the committee on fire, water, light and power at the city clerk's office until March 22 for furnishing and erecting three complete 47-kw. exciter generators in the power house at Point du Bois, Manitoba.

UKIAH, CAL. — The Snow Mountain Water & Power Company has been granted permission by the State Railroad Commission to issue $1,500,000 in capital stock, the proceeds to be used to construct a dam at the Gravelly dam site and for improvements to its power house and service in Lake County.

MONTREAL, QUE.—Tenders will be received by the Lignite Board of Canada, 2 Youville Square, Montreal, until March 20 for furnishing three 72-in. x 18 ft., horizontal return tubular boilers, built to conform to the requirements of Saskatchewan. Specifications and further information may be obtained at the office of the secretary of board. Leslie R. Thomson is secretary.

Miscellaneous

ARECIBO, PORTO RICO.—The installation of one 75-kw. generator and a 100-hp. Meitz & Weiss engine in the municipal electric light plant is contemplated. Extensions will also be made to the transmission lines. J. M. Gonzalez is superintendent.

Record of Electrical Patents

Notes on United States Patents

(Issued Feb. 24, 1920)

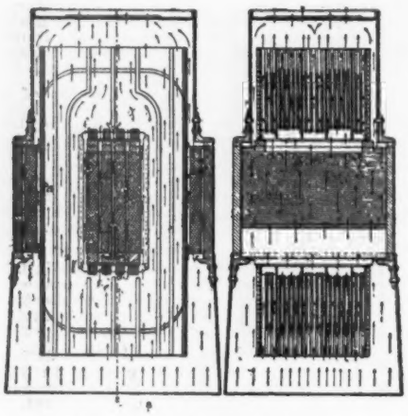
1,331,486. PLAITING MACHINE; Thomas E. Clark and Charles W. Ward, Detroit, Mich. App. filed Jan. 8, 1918. Resistance for heating rolls.

1,331,496. ELECTRIC HEATER; John R. Goldthwaithe, Atlanta, Ga. App. filed Dec. 4, 1915. Melts wax when sealing.

1,331,568. RIVETING MACHINE; George A. E. Jones, New London, Conn. App. filed Nov. 10, 1919. Two rivets in series heated and prepared for heading dies.

1,331,571. ELECTROLYTIC CELL; Ernest A. Le Sueur, Ottawa, Ont., Canada. App. filed Jan. 25, 1919. Heavy current to sheets beneath surface of electrolyte.

1,331,625. FLEXIBLE CONNECTION FOR ELECTRIC FURNACES; James H. Critchett, Niagara Falls, N. Y. App. filed July 19, 1919. Reduces mutual inductive effect.



No. 1,331,896—Transformer

1,331,640. SENDING DEVICE FOR SUBAQUEOUS-CURRENT-LINE TELEGRAPHY; Walter Hahnemann, Kitzeberg, near Kiel, Germany. App. filed Jan. 29, 1915. Impulses sent through water by alternating-current generator from iron vessels.

1,331,634. ATTACHING PLUG; Thomas D. Finzio, Kitchawan, N. Y. App. filed March 3, 1916. Removes plug from socket without twisting cord.

1,331,669. TELEPHONE MOUTHPIECE; William M. Parker, Parkersburg, W. Va. App. filed Dec. 6, 1917. Combined metal and porcelain construction.

1,331,756. ELECTRIC LIGHT FIXTURE; Richard S. Giese, Pittsburgh, Pa. App. filed Feb. 12, 1919. Combined ceiling bowl and shade.

1,331,761. DRY CELL; Clarence W. Hazelett, Lakewood, Ohio. App. filed May 9, 1919. Cell construction prevents excessive corrosion.

1,331,762. DRY CELL; Clarence W. Hazelett, Lakewood, Ohio. App. filed May 9, 1919. Lining with insulated coating.

1,331,763. DRY CELL; Clarence W. Hazelett, Lakewood, Ohio. App. filed May 9, 1919. Spot welding binding post to zinc.

1,331,764. ELECTRIC BATTERY; Clarence W. Hazelett, Lakewood, Ohio. App. filed May 9, 1919. Applies celluloid cement outside of cell.

1,331,773. STATION INDICATOR; Lloyd Keeling, Denver, Col. App. filed July 5, 1917. Motorman operates device by foot power.

1,331,780. SYSTEM OF HOIST CONTROL; Ray C. Newhouse, Wauwatosa, Wis. App. filed June 17, 1911. Automatic skip-hoist system may be manually controlled.

1,331,815. AUTOMATIC ELECTRIC REGULATING DEVICE; August Kazenmaier, Stuttgart, Germany. App. filed Oct. 28, 1918. Pressure plate controls alterable resistance.

1,331,819. ELECTRIC TOASTER; Edward P. Taylor, Ottawa, Ontario, Can. App. filed Feb. 20, 1919. Both sides of slice toasted simultaneously.

1,331,867. AUTOMATIC REGULATOR; Arthur W. Greene, Richmond, Va. App. filed Jan. 22, 1917. Controls either or both draft and stoker conditions.

1,331,877. ELECTRIC BATTERY; Otto E. Ruhoff, Madison, Wis. App. filed July 5, 1918. Cell kept three years without deterioration.

1,331,888. COATED STRAIN-HARDENED METAL; Willis R. Whitney, Niskayuna, N. Y. App. filed June 15, 1918. Springs coated with metallic tin, electroplated without injury.

1,331,896. TRANSFORMER; Frederick F. Brand, Pittsfield, Mass. App. filed Nov. 21, 1916. Improved ventilation shell-type transformers.

1,331,898. REGULATING SYSTEM; Robert M. Carothers, Schenectady, N. Y. App. filed May 27, 1919. Increases range of regulation.

1,331,915. DEMAND APPARATUS; Chester I. Hall, Port Wayne, Ind. App. filed Dec. 9, 1916. Periodically restores indicating element to zero position.

1,331,936. BARRIER OR ARC DEFLECTOR FOR DYNAMO-ELECTRIC MACHINES OF THE LIKE; Jesse J. Linebaugh, Schenectady, N. Y. App. filed March 6, 1918. Prevention of flash-overs or arcing between sets of commutator brushes.

1,331,940. ELECTRIC SHIP PROPULSION; Henry M. Hobart, Schenectady, N. Y. App. filed May 19, 1916. High-speed elastic-fluid turbine direct-connected to a polyphase induction generator.

1,331,967. X-RAY TUBE; Ralph H. Small, San Francisco, Cal. App. filed Dec. 8, 1917. Regulates vacuum within tube.

1,331,970. COIL-END SUPPORT; Robert B. Williamson, Milwaukee, Wis. App. filed Oct. 8, 1914. Holds projecting-end portions of coils of large alternators.

1,331,979. AUTOMATIC LIGHT REGULATOR FOR MOTION-PICTURE APPARATUS; Charles R. Carleton and Gideon W. Carleton, New York, N. Y. App. filed March 16, 1916. Electromagnetic switch controls circuit through resistance coil and light.

1,331,998. ELECTRIC GENERATOR; Alfons H. Neuland, Jersey City, N. J. App. filed Dec. 24, 1917. For both ignition and lighting currents without objectionable interference by either coil.

1,332,017. SPARK-PLUG TESTER; William S. Wolff, St. Paul, Minn. App. filed March 28, 1919. Air supplied to spark plug while being tested.

1,332,029. ELECTRIC HEATING APPARATUS; Ora A. Colby, Larimer, Pa. App. filed Sept. 21, 1916. Exposed resistances.

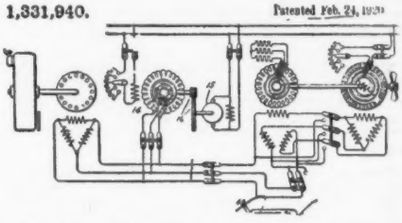
1,332,030. ELECTRICAL RESISTANCE; John Collinson, Manchester, Eng. App. filed Sept. 9, 1916. Grid type made from expanded metal.

1,332,032. STARTING MECHANISM FOR AUTOMOBILES; William A. Dick, Pittsburgh, Pa. App. filed Aug. 28, 1915. Flywheel part of magnetic circuit.

1,332,040. SWITCH; Paul M. Hengstenberg, Wilkinsburg, Pa. App. filed Jan. 10, 1917. Thermal-responsive quick-acting type.

1,332,052. ELECTRIC AIR HEATER; Emanuel A. Martin, New York, N. Y. App. filed June 19, 1918. Flue shaped to conduct cold air through heater.

1,331,940. Patented Feb. 24, 1920.



No. 1,331,940—Electric Ship Propulsion

1,332,078. SEPARATION AND EXTRACTION OF DUST AND IRON FROM BRASS BORINGS, BRASS TURNINGS AND LIKE MATERIAL; Walter Sowden, Leeds, Eng. App. filed July 20, 1917. Magnetic separation with air blast.

1,332,133. SUPPORT FOR TELEPHONE RECEIVERS; August G. Mass and Louis Nusbaum, Cincinnati, Ohio. App. filed May 24, 1919. Receiver returns to inactive position.

1,332,155. METHOD OF WELDING; Vincent G. Apple, Dayton, Ohio. Rapid discharge of current from inductive circuit localizes heat.

1,332,167. LIQUID RHEOSTAT; George F. De Wein, Milwaukee, Wis. App. filed Nov. 6, 1918. Rapid discharge of electrolyte secured by weir-type rheostat.

1,332,172. CIRCUIT-BREAKER TERMINAL; George N. Frey, Pasadena, Cal. App. filed Oct. 16, 1918. For sectionalizing switch.

1,332,182. SYSTEM OF AUTOMATIC CONTROL; Morris E. Leeds, Philadelphia, Pa. App. filed Aug. 1, 1917. Electrical, thermal or chemical condition maintained constant.

1,332,184. PROCESS OF ELECTRIC WELDING; James L. Adams, Jr., Milwaukee, Wis. App. filed Nov. 3, 1919. Welding tubes from sheet-metal plates.

1,332,186. PROCESS OF ELECTRIC WELDING; Joseph W. Fay, Milwaukee, Wis. App. filed Nov. 3, 1919. Fusible metallic electrode and welding ribbon used.